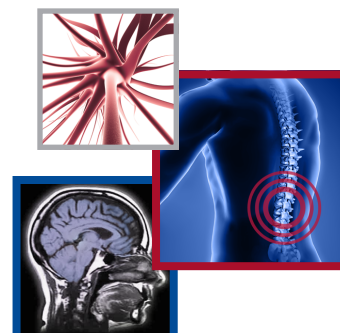


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# Social pain and physical pain: shared paths to resilience

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## Practice points

### Overlap of physical & social pain

- Emerging neuroscience and psychological evidence suggests a substantial overlap between physical pain and social pain, which includes commonalities in genetic variants, inflammatory responses and neural pathways.
- Social pain, like physical pain, may serve an adaptive evolutionary function, which may explain its similarities with physical pain.

### Social factors & vulnerability in chronic pain

- Social factors may increase vulnerability to chronic pain via both focal exposure to major life stressors (e.g., trauma) and through chronic exposure to socially painful situations (e.g., ostracism, isolation and prolonged social conflict).
- Heightened pain sensitivity and maladaptive pain coping may be more likely due to exacerbated negative emotional states that are reactive to social factors such as stress and interpersonal conflict.

### Social factors & resilience in chronic pain

- Two primary contributors to more effective pain adaptation are positive emotional states and meaningful social ties, including social support, which may predict lower levels of pain intensity and bolster more effective psychological responses under painful conditions.

### Social relationships of those in chronic pain: the importance of social intelligence

- The presence of social support is not always a sufficient condition to promote effective pain adaptation, as overly responsive social networks may compromise self-sufficiency and underutilized social networks may not confer maximal benefits to psychological well-being and pain coping.
- Greater attention to individual factors, such as goals and strategies for bolstering enjoyment and meaningful interactions with one's social networks, may yield benefits in improving physical and psychological functioning.
- Novel interventions, such as those to enhance social intelligence, may help to address the social distress and decreased interpersonal enjoyment that are common in people with a chronic pain condition.

### Interventions for caregivers

- Addressing the adaptation of caregivers and family members of individuals with chronic pain may serve to ameliorate the pain and emotional distress experienced by both patients and their loved ones.
- Interventions for clinicians that enhance compassionate and empathic responses to patients with chronic pain may enhance therapeutic alliance and improve treatment outcomes.

### Future directions for study

- Positive psychology interventions are a promising area of psychological intervention that may improve interpersonal ties and bolster positive emotions in individuals with chronic pain, though additional study is still needed to establish their efficacy.
- Although psychotherapy is generally considered a relatively low-risk intervention, there is relatively little evidence examining what, if any, risks this approach may pose in the context of treatment for chronic pain.

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Although clinical models have traditionally defined pain by its consequences for the behavior and internal states of the sufferer, recent evidence has highlighted the importance of examining pain in the context of the broader social environment. Neuroscience research has highlighted commonalities of neural pathways connecting the experience of physical and social pain, suggesting a substantial overlap between these phenomena. Further, interpersonal ties, support and aspects of the social environment can impair or promote effective adaptation to chronic pain through changes in pain perception, coping and emotional states. The current paper reviews the role of social factors in extant psychological interventions for chronic pain, and discusses how greater attention to these factors may inform future research and clinical care.

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## KEYWORDS

- chronic pain • negative emotions • pain coping
- pain perception • positive emotions • psychological interventions • resilience
- social pain • social support

Pain has long been defined as a multidimensional construct; traditionally, researchers have acknowledged not only the physical or sensory aspects of pain, but also the cognitive and emotional aspects of pain [1]. Early models proposed that the experience of pain in humans occurs in a relatively invariant sequence of events. For example, Wade and colleagues [2] proposed that pain is experienced in 4 stages: pain is first experienced according to its sensory-discriminative features that indicate the location, timing and other physical aspects of the pain experience; immediately following the sensory experience of pain, individuals experience an affective reaction to pain that may evoke, for example, fears of threat or bodily damage; the experience of pain is then modified by cognitive processes that may involve prior painful experiences, the current context of pain experience, and expectations and beliefs about the short- and long-term consequences of pain; and pain is expressed via overt and visible behaviors that may have longer term physical and social consequences (e.g., avoiding painful activities, grimacing, bracing and protecting painful areas). These models have emphasized that behavioral changes occur only at a comparatively later stage during the experience of pain, while elements of the social world are acknowledged primarily as outcomes of the experience of pain, rather than contributing factors.

Other key early models in chronic pain have sought to quantify pain signaling and explain how nociceptive signals may be modified by CNS factors, such as descending inhibitory processes from the brain [3]. The Gate Control Theory of Pain emphasized, for example, that psychological variables such as past experience and ascribed meaning of pain might be activated by activity of large nerve fibers and play a

role in inhibitory pain processing [3]. Similarly, some researchers examined the role of learning processes in pain, suggesting that individuals develop adaptive or maladaptive responses to pain based on environmental and internal contingencies, such as the magnitude of pain exacerbation or relief after performing an activity [4]. In these models, psychological factors were proposed as modifiers of the general processes of pain transmission and subsequent behavioral responses. However, although these models did acknowledge environmental factors as contributory in pain processing and coping, they primarily characterized pain as a phenomenon that has implications only for the internal states of the person experiencing pain.

In recent years, there has been a proliferation of research examining not only the effects of pain on the sufferer, but also an increasingly large emphasis on the transactional relationships between pain within the sufferer and various aspects of the social environment. In this paper, we will review the evidence suggesting a significant psychological and neurological overlap between physical and social factors underlying the experience of pain, how these factors impede or facilitate pain adaptation, and review their potential role in existing and future interventions.

Early models examining the role of social factors in pain focused on constructs like social support, which has demonstrated broad value in explaining trajectories of pain-related adaptation [5]. These models emphasized a transactional model: when pain causes a problem, it may spur changes in mood or behavior and prompt a supportive response from others. More recently, this model has been expanded significantly by neuroscience research that has connected the experience of physical pain with the

experience of 'social pain', including experiences of ostracism, loss and interpersonal conflict, by identifying a shared underlying neural pathway. The role of this shared neural pathway was first suggested by functional MRI studies in the early 2000s, which reported that regions of the brain that have been traditionally associated with the salience of pain and pain-related distress, the dorsal anterior cingulate cortex and ventral prefrontal cortex, also show similar patterns of activation in paradigms designed to elicit social pain through social exclusion [6]. Subsequently, this model has been expanded to include the insula, another region that has been traditionally associated with physical pain [7]. Similar neural activation patterns have since been reported in the experience of social rejection [8] and both acute [9] and prolonged bereavement [10].

The overlapping nature of physical and social pain has also been supported by clinical and experimental data. Prior studies have indicated that measures such as cutaneous heat pain sensitivity are correlated with the degree of distress reported after a social exclusion paradigm [11]. Similarly, observational studies have found that daily ratings of loneliness, a socially based negative emotional state, are predictive of later pain intensity [12]. The connection between physical pain and social factors may be explained by several factors, including cognitive and physiological processes. Wolf and colleagues note that the relationship between loneliness and pain intensity appears to be mediated by increased levels of pain catastrophizing, suggesting that cognitive appraisal of pain and social processes may be a key mechanism [12]. Similarly, this overlap between physical and social pain may be connected by inflammatory responses in the body. Social stressors have been found to correlate to increased circulation of proinflammatory cytokines [13]. Similarly, proinflammatory cytokines like IL-6 have been found to mediate the relationship between social exclusion and depression [14], and show correlations with pain intensity in some populations [15]. The role of inflammatory processes in social pain has also been emphasized by DeWall and colleagues, who reported that a 3-week course of the NSAID acetaminophen buffered against feelings of social pain after a social exclusion paradigm [16]. These authors noted that these effects appear to be mediated by decreased activity in the dorsal anterior cingulate cortex and anterior insula, both regions implicated traditionally in physical

pain. Emerging evidence suggests that genetic factors may also affect this phenomenon; gene polymorphisms in the  $\mu$ -opioid receptor gene, a gene that has been strongly associated with physical pain, predict not only ratings of pain unpleasantness, but also ratings of social pain in response to experimental social exclusion paradigms [17].

So, why might physical and social pain demonstrate similar patterns of activation and processing in the brain? Recent theories have suggested that pain is an important self-regulatory signal that aids the organism in directing efforts to return the body to its natural homeostatic set point [18]. It is in this way that acute physical pain serves a key biological and evolutionary function: to spur adaptive responses when an organism is experiencing heightened threat or physical harm. In evolutionary models that define physical pain as arising from tissue damage, the presence of pain provides an important indication regarding the safety of the organism; when pain is present in its acute form, it fosters unpleasant and distressing psychological states that lead to protective responses, such as avoiding use of the injured area and avoidance and escape behaviors to prevent further damage. This paradigm of acute pain as a physical safety mechanism has subsequently been applied to evolutionary models for explaining social pain; just as physical damage to an organism threatens its long-term survival, so too might separation from the organism's social group. Given that humans have historically thrived in communities, loss of a community and the protections it provides (e.g., from predation or starvation) likely predicts a much higher rate of mortality [19]. Consequently, social pain may have promoted physical safety in a similar manner as physical pain; when a 'socially painful' event has occurred, it may spur the individual to repair the social schism or to seek new sources of support. Although aversive or distressing social experiences may not constitute an equivalent experience to physical pain, this evolutionary model does suggest that social pain plays a similar role to physical pain. Given that both physical and social pain might be expected to foster long-term survival, it is not unreasonable to expect that they may interact in determining the affective, cognitive and behavioral reactions to pain.

Although the aforementioned findings provide a compelling indication that physical and social pain may share a much greater degree of

similarity than once thought, it is also important to note that this area of study remains in a relatively early stage. For example, some researchers have recently challenged the assertion of shared common pathways for physical and social pain, noting that underlying neural representations of these phenomena may vary significantly, despite similarities in activation patterns across broader neuroanatomical regions [20]. These findings suggest that the level of analysis concerning these processes is of central importance, and that the degree of overlap of physically and socially painful experiences may depend on how they are measured. Consequently, continued replication of these findings remains an important step for future empirical models.

In summary, evidence connecting the phenomenological and physiological aspects of physically and socially painful experiences constitutes an emergent but fruitful area of research. However, physical pain and social factors have long shown a relationship of mutual influence. In the next section, we will discuss the significant role of social factors in clinical and empirical models of pain.

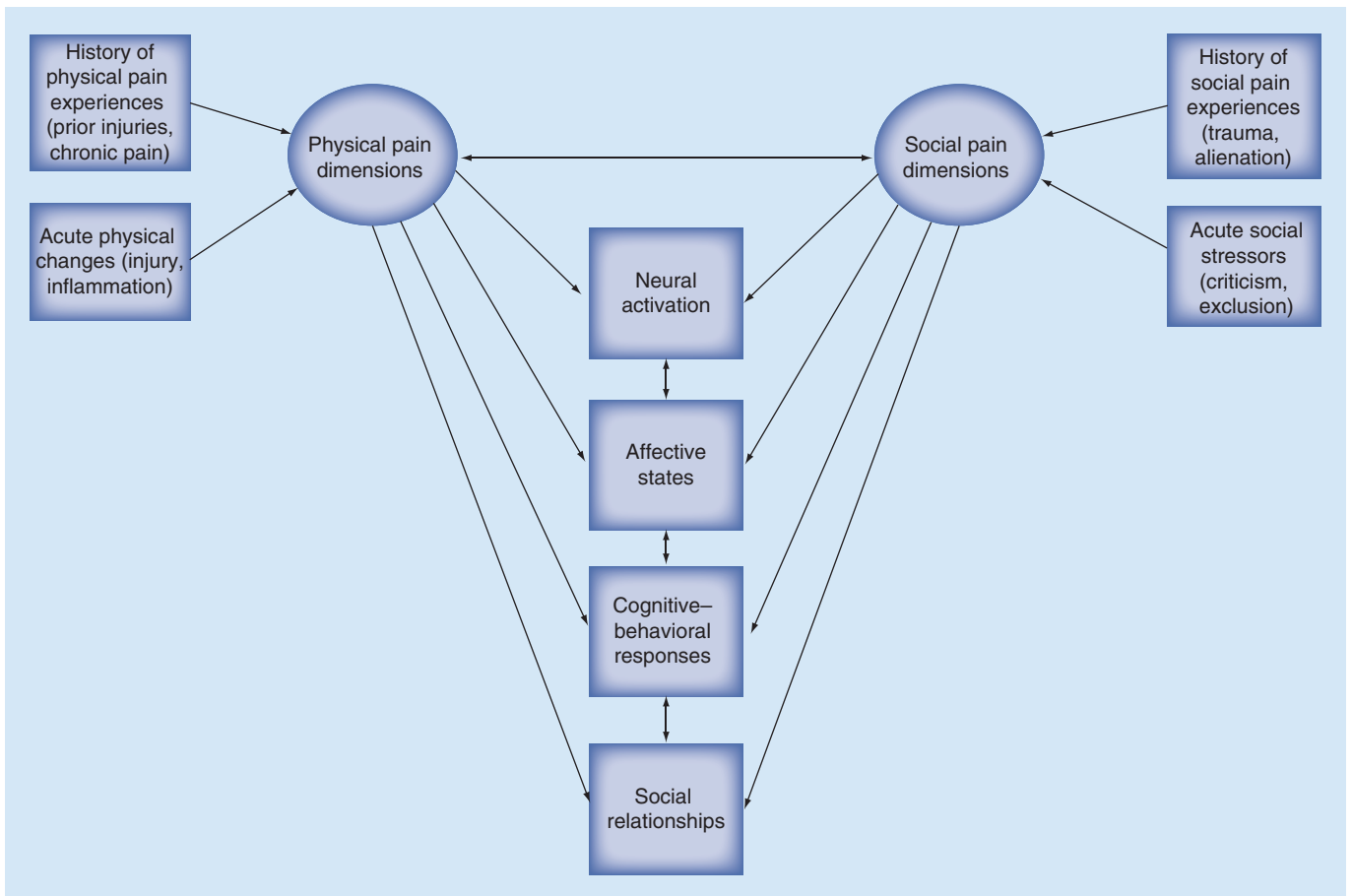
### Social factors & vulnerability in chronic pain

Social factors have long been linked to the etiology and maintenance of chronic pain. In addition to the potential overlapping patterns of neural activation described in the previous section, social and physical pain may interact through a variety of other mutually influential factors, including cognition, behavioral responses, affective states and neurophysiological responses (see [Figure 1](#)). Notably, there has been considerable evidence that the social environment may play a protective or exacerbating role in the development of chronic pain. One salient social factor is early life stress; trauma and other major stressors early in life have been shown to predispose individuals to increased rates of chronic pain later in life [21]. Though some degree of this effect appears to be due to differences in nervous system function after trauma [22], early life stressors may also predispose an individual to exposure to other stressful environments at a later time, thereby perpetuating their deleterious consequences [21].

However, it is not only focal and highly stressful events early in life that may increase vulnerability to chronic pain, as more chronic forms of social stress, such as prolonged isolation,

ostracism or social conflict, may be etiologic in the development of later chronic pain [23]. In much the same way that the experience of physical pain may inspire negative emotional states, activate cognitive appraisal patterns, and spur behavior changes, a similar response pattern may be noted in situations that provoke acute social pain. In situations indicating an emergent threat, such as a broken bone or an external threat to physical safety, responses such as escape, hostility or avoidance may be useful. However, models of chronic physical pain have highlighted how behaviors that may be adaptive when an individual experiences acute pain (e.g., avoiding activities that increase pain, engaging in social behaviors that signal a need for help) may develop into patterns of behavior that are maladaptive and impair long-term health when pain is chronic. Similarly, when an individual experiences a form of social pain (e.g., social exclusion or rejection), their responses may be situationally appropriate (e.g., feeling angry or avoiding a group after being rejected). However, when social pain becomes a chronic issue, this may compromise self-esteem, increase aggression against others, and lead to less effective coping [24] and prosocial behavior [25]. When prosocial behaviors are reduced, individuals may become less likely to attempt to repair their social relationships when problems arise, prolonging difficulties with social alienation and contributing to less utilization and benefit from existing social support [26]. Of note, socially painful events may create ‘socially painful memories’ that foster a persistent fear of rejection, which increases the risk of later psychological difficulties [27] and exacerbates social problems by decreasing prosocial behavior and leading to poorer appraisals of existing relationships [28]. As a result of these social challenges, individuals may face elevated risks of chronic physical pain due to a variety of factors, including a hypervigilance to both socially and physically threatening cues, insecure styles of interpersonal attachment and impaired processes of self-regulation [23].

In cases of social pain, the difficulties stemming from these situations may interact with perception and coping processes in physical pain; there are mechanisms that are both responsive to social factors that influence pain perception and adaptation in both experimental and observational studies, most notably affective states. Negative emotional states are commonly found to exacerbate pain intensity [29,30]. Social



**Figure 1. Conceptual model depicting antecedents and shared mechanisms of physical and social pain.**

problems, in turn, are a key precipitant of these negative emotional states [31,32]. Indeed, there is evidence that social factors may play a more salient role in pain-related mood dysregulation than overall physical ability [33]. Unfortunately, evidence also suggests that individuals with a chronic pain condition are vulnerable to more frequent social conflict [31] and show greater reactivity to interpersonal stressors [34]. There is also evidence that emotional states and social functioning are mutually influential: the severity of current depressive symptoms is predictive of poorer psychosocial functioning, above and beyond the experience of pain [35], and individuals tend to appraise their social relationships more negatively when experiencing elevated levels of stress or negative emotion [36]. These findings suggest that both the presence of social conflict and the evaluation of one's social relationships have implications for emotional states in chronic pain. Further, given that both conflictual social interactions and physical pain may increase emotional distress, it may be that the

emotional suffering inspired by these challenges may interact and complicate effective adaptation to pain.

In addition to social conflict, there are also significant pain-related risks to those individuals who do not have access to sufficient levels of social support or those who do not fully utilize the social resources at their disposal. Withdrawal from one's social relationships, a common issue with elevated pain, has been shown to worsen the emotional consequences of chronic pain [32]. Similarly, individuals with chronic pain who report higher levels of isolation tend to report greater levels of depression [37] and lower levels of physical functionality [38]. Interestingly, the pain-exacerbating effects of loneliness may be explained to some extent by dysregulations in stress hormone activity and gene transcription, which increase long-term vulnerability to inflammatory disorders [39]. Given the relationship between inflammation and pain in some disorders [15], these effects may translate to chronic pain disorders, as well.



### Social factors & resilience in chronic pain

Although problems in the social environment can exacerbate pain and pain-related disturbances in daily life, positive aspects of one's social world may improve coping responses and overall function for individuals with chronic pain. There are a few key variables that have proven to be powerful predictors of effective adaptation to pain: social relationships and positive emotion. Social relationships may enhance pain coping both directly, via provision of social support, and indirectly, by enhancing other factors that improve resilience to pain through enjoyable or positive interpersonal exchanges. Early definitions of resilience in adults identified effective utilization of social resources as a key contributor to effective coping [40,41], and subsequent definitions regarding pain-specific resilience have echoed the importance of this process [42,43]. Indeed, social support has been found to meaningfully predict ratings of pain and functional status in individuals with chronic pain 5 years later [5]. Greater social support has been associated with lower levels of pain intensity in response to painful experimental stimuli, and these effects have been noted regardless of whether the supportive other is physically present [44,45]. Meaningful social connections may also serve a protective role in reducing nervous system responses in response to pain and stress [44] and by engaging neural networks associated with more adaptive responses to pain, such as reward circuitry [45]. Individuals receiving social support also appear to be more likely to engage in prosocial behavior, protecting them against pain-related exacerbations in negative mood [46].

Similarly, positive emotions are among the most important predictors of effective pain adaptation [42,43], and are accessed significantly via one's social relationships [32]. Positive emotional states have demonstrated a variety of benefits in both healthy individuals and in those with a chronic pain condition, including enhanced stress recovery [47], improved immune function [48] and better cognitive performance under stressful conditions [49]. Positive affective states also demonstrate a variety of pain-specific benefits, including reducing ratings of pain intensity [50], promoting adaptive cognitive responses to pain [51] and increasing the ability to persist in goal-directed behavior under painful conditions [52]. It is thus clear that positive emotional states are key predictors of positive pain-related outcomes. However, the relationship between

the social world and positive emotions is decidedly complex, particularly for individuals living with a chronic pain condition.

### Social relationships of those in chronic pain: the importance of social intelligence

Although the presence of social support is a key ingredient in positive pain coping, the mere presence of supportive others does not guarantee either short-term or long-term positive benefit. Indeed, there are a number of moderating factors that determine the extent to which an individual with chronic pain may utilize or benefit from extant social support. Broadly, it has been suggested that the quality of social support, rather than the quantity of people within one's social network, is likely a more important predictor of beneficial social support [53]. In fact, some individuals with chronic pain may show decrements in their physical or psychological function if their social network is excessively supportive, which may compromise the development of self-sufficiency and effective pain coping [53].

There are also important cognitive factors at play in social relationships. For some, the presence of emotional or instrumental support may be rated as more important than relief from pain or negative emotions [54]. Similarly, some individuals with chronic pain may emphasize social validation of their pain above all other goals, as they may feel ostracized or isolated due to a belief that their pain is poorly understood by others. However, this predominant focus on social validation has been associated with less positive functional outcomes, as it may come at the expense of attempts to remain self-sufficient [55]. For example, individuals with pain who experience more frequent solicitous behavior from their loved ones tend to show poorer adjustment to pain and a greater vulnerability to disability [56,57]. Individual goals are therefore of central importance in determining the degree of benefit one receives from his or her social support network: for an individual who has maintained focus on improving function, this support may serve as a key stepping stone back to engagement in personally meaningful activities. However, when one's social network shows an excessive or deficient response to the needs of a person with pain, the goals of that individual may gravitate toward garnering additional support, even if this support comes at the cost of self-sufficiency.

These findings highlight the complexity of the social relationships of those individuals

living with chronic pain. It is not simply that the presence of others and whether they are willing or able to provide support that predicts more positive trajectories of adaptation to chronic pain. Rather, it is equally meaningful to identify ways to reverse the troubled relationships of chronic pain sufferers with their peers and loved ones and to identify ways in which these individuals can establish new positive social connections and enrich their current sources of positive interpersonal engagement. In existing psychological treatments for chronic pain, social relationships are often addressed as an incidental, rather than central, focus of intervention. In cognitive-behavioral therapy (CBT) for pain, treatment may target deficiencies in social function, either through the use of assertive communication strategies to address difficult or conflictual relationships, or through a planned approach toward reincorporation of positive interpersonal events, as in the case of positive activity scheduling [58]. Incorporation of these techniques in CBT for pain assumes a specific set of difficulties experienced by individuals with pain; more specifically, targeting of communication strategies appears intended to address feelings of alienation or being poorly understood by others, while helping patients to re-establish appropriate boundaries and expectations in their social relationships, which may require recalibration due to limitations or challenges caused by physical pain. Positive activity scheduling, meanwhile, may provide incremental value for patients with chronic pain, who may avoid positive social activities due to pain [32] and may thus benefit from behavioral activation approaches, particularly those with a social focus.

In newer wave treatments for chronic pain, such as acceptance and commitment therapy and mindfulness-based stress reduction, treatments are largely nondirective and a greater emphasis is placed on personally held values; while the flexibility afforded in these approaches is likely to be a largely positive influence, they may or may not emphasize interpersonal relationships as a central component of effective pain coping. One exception is loving kindness meditation, which is traditionally included in mindfulness-based stress reduction and does emphasize compassion toward not only the self, but also others; this meditation has shown some benefit in the context of improving important interpersonal factors such as the ability to take perspectives

other than one's own [59]. Similarly, there is also some evidence that acceptance and commitment therapy may have benefits in the context of bolstering social function, which may be achieved through a focus in enhancing psychological flexibility [60]. However, it is possible that these findings may be secondary to a broader psychological improvement that occurs as a result of these treatments, as patients commonly report significant improvement in their levels of emotional distress and greater overall function after completion of these treatments [61]. It is important to note that we are not proposing that these interventions do not positively affect social function, but rather that their broader scope may not leave sufficient time to ameliorate psychosocial distress that may co-occur or even predate an individual's ongoing pain symptoms. In sum, the extant psychological interventions for chronic pain have typically not made social relations a central focus, and their benefits in this area may be secondary to emphasizing other factors that are broadly applicable to both pain coping and interpersonal relationships, such as improved mood, reduced behavioral avoidance and promotion of nonjudgmental perspectives. Consequently, a more explicit focus of treatment on ameliorating interpersonal distress and enriching enjoyment of one's relationships may serve to provide even greater benefit in this domain.

One potential intervention that may help to address these interpersonal issues in chronic pain may focus on bolstering social intelligence. Recently, an online social intelligence intervention has been developed that targets the development of skills that are instrumental in sustaining positive social relationships [62–65]. The social intelligence training program utilizes recent evidence from social neuroscience and emphasizes the humanization of relationships with attention to cognitions that facilitate healthy social connections [66]. However, the approach extends beyond cognitive models and behavioral principles to include attention to evidence of barriers to social-emotional development from adverse experiences in childhood and adult life, and ways to move beyond those stressful experiences. Recent empirical evidence shows this type of program offers a promising resource for chronic pain patients and those who care for them [64,66]. We, along with others, are currently engaged in developing a parallel program, tailored to the social relationship challenges among chronic pain patients [67].

### Interventions for caregivers

Another way to address the social factors at work in individuals with chronic pain is to develop interventions that incorporate family members into the treatment itself. Indeed, interventions targeting the relationships of individuals coping with a chronic condition have benefits both for the psychiatric distress of the individual with pain and in terms of reducing psychiatric distress and perceived levels of family burden [68]. This approach has been adopted more readily in the cases of pediatric and adolescent chronic pain, where family functioning is not only a contributor to adaptation, but also regularly referenced as a meaningful outcome [69]. In adults with chronic pain, a more regular area of inquiry is the examination of interventions focusing on marital relationships when one partner has a pain condition; meta-analyses of extant treatments suggest that couple-focused interventions may reduce pain and emotional distress while improving family functioning, though effect sizes are generally small [70] and may not be consistent, particularly with regard to the effects of marital relationship factors on pain intensity [71].

The value of positive social relations between professional healthcare providers and their patients is also critical. Evidence suggests that the relationship between patient and provider consistently predicts outcomes in overall medical care, though the relationship has been somewhat understudied in chronic pain populations [72]. When these relationships are characterized by a more prominent belief that pain is due to a psychosocial cause, providers may feel that the patient is trying to be deceptive and may feel less empathy and more mistrust toward the patient, compromising the quality of the treating relationship [73]. Similarly, patients who feel that their providers do not believe the legitimacy of their pain complaints may begin to feel stigmatized by the ‘invisible’ nature of their conditions, making them more susceptible to emotional distress and social isolation and decreasing their willingness to seek appropriate care in the future [74]. These findings highlight the potential value of interventions that may facilitate compassionate and empathic responses from pain practitioners, in order to improve treatment response and reducing attrition from treatment.

Attention to patient concerns has a rich tradition within healthcare, especially nursing. Current efforts to elevate the quality of care to elders in life-care facilities fall under the

umbrella of an approach referred to as ‘person-centered care’. Kitwood [75], a British gerontologist, introduced person-centered care as an aspirational goal for elder care: to humanize social interactions between patient and healthcare providers [76]. The Social Intelligence Institute [77], for example, is training direct care workers at life care communities to see those they care for as fellow humans with needs and wants rather than as a collection of body parts that demand attention. Physicians are important yet elusive targets for these types of interventions. The time it takes to acknowledge the humanity of those under their care is measurable in seconds, but an emphasis on humanizing the relationships between physicians and patients has remained relatively underemphasized in current training models.

### Future directions for study

It is also worth noting some emergent interventions in the context of chronic pain that focus on enhancement of positive psychological states. In the past 2–3 years, researchers have begun to devote additional attention to adapting exercises and treatments that have long been connected to psychological health in non-pain areas, such as depression. These interventions have attempted to encapsulate traditional positive psychological approaches by targeting mechanisms that bolster positive emotional states and improve social relations. These activities may include exercises that promote forgiveness of others for prior harms, sharing of gratitude with supportive others, promoting prosocial behaviors (e.g., performing random acts of kindness), cultivating compassion toward the self and others, savoring positive experiences, enhancing optimism and pursuing personally meaningful goals [78,79]. These interventions constitute a promising step away from treating pain using strictly a problem-focused approach and instead promoting overall health and meaningful function. However, to date, there have been relatively few studies that have examined the efficacy of these treatments in chronic pain, and existing data are limited. The Müller study reported promising results suggesting improvements in multiple domains in individuals with chronic pain and a co-occurring physical disability, including pain intensity and perceived pain control, by delivering a customizable online intervention using several of these techniques [78]. Flink and colleagues, who utilized a replicated single-case



design, reported some improvements in disability ratings and the severity of catastrophic appraisals of one's pain; however, the size of these effects was relatively modest [79]. It thus appears that additional study is warranted to determine whether these approaches are sufficient as a standalone treatment for chronic pain, or whether they are better employed as supplemental techniques in existing treatment protocols, such as CBT.

From a broader perspective, there is also a relative lack of research examining the possibility of adverse effects of psychotherapy, which may be due to a manipulative or otherwise poor therapeutic alliance or through a failure of the provider to promote independence and effective coping outside of therapy sessions, thereby fostering dependence on therapy itself [80]. Although some studies have noted that these risks likely do exist in some cases, particularly in cases where therapists may not be adequately trained in ethics and effective psychotherapeutic techniques [81], this possibility has not been directly addressed in the context of medical or psychological treatment in chronic pain, and warrants attention in future studies.

Although we have proposed a conceptual model to explain the potential overlap between physical and social pain, it should be viewed as a preliminary model that requires refinement through further empirical study. There are several ways that it may be possible to improve our model by revising or replicating the paths we have proposed. The directionality of effects between domains of pain experience remains to be clarified in many cases; it may be that certain variables demonstrate a degree of mutual influence with others, while other effects may be better characterized as unidirectional. For example, Wolf and colleagues [12] provide evidence that feelings of loneliness may predispose individuals to experiencing more intense pain at a later time by increasing an individual's tendency to appraise their pain as being a catastrophic influence on his or her life; however, it may also be that pain may induce loneliness by disrupting valued social activities, which may impair an individual's ability to seek the degree of social engagement that they might otherwise desire. Further, it may be that some of the domains proposed in our model share significant overlap, as in the case of the overlapping neural regions implicated in social and physical pain; in these cases, it may be worthwhile to determine if there

are superordinate constructs that may explain the degree of overlap in these constructs, or whether delineations between these constructs may be found by adopting different analytical approaches, as suggested by Woo [20]. Similarly, it may be that some of these constructs may be related spuriously by third variables not yet incorporated into our model. For example, it may be that neuroticism, a personality trait commonly associated with increased negative emotionality, may increase levels of emotional distress and maladaptive cognitions in situations that are either physically or socially painful, thereby inflating the correlation between these variables. In sum, there remains considerable work to be done to better characterize the degrees of overlap and distinctiveness of domains that may connect the experiences of physical and social pain.

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## Conclusion

In the past three decades, significant advances have occurred in the conceptualization and treatment of chronic pain. In recent years, this improvement has included an increased emphasis on examining not only the effects of pain within the individual, but also the importance of examining the social context in which pain occurs. Pain itself may be more appropriately considered as both an internal and social phenomenon, based on the evidence provided from psychological and neuroscience research. Consequently, there is significant value in emphasizing the importance of social factors in future studies, in order to characterize trajectories of vulnerability and resilience for people facing chronic pain and to more effectively treat concurrent social factors that may serve to either facilitate or impede effective pain adaptation.

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## Future perspective

Incorporation of social factors into medical and psychological interventions for chronic pain may significantly enhance their benefit. Elucidation of the social influences on pain experience, pain coping and medication use can help to highlight new and novel targets for intervention. In the future, interventions will promote wellness in chronic pain by addressing not only the efforts of the patient to adapt to pain, but also the social context within which pain adaptation occurs. This process may occur by treating the reactions of loved ones who may be closely involved in the care of the patient (e.g., family members)

and by identifying strategies for enhancing the therapeutic relationship between patients and providers. With the accumulation of emergent neuroscience and psychological evidence that highlights the overlap between physical and social pain, the conceptualization of pain will move closer to being truly multidimensional, necessitating the examination of physical, psychological and social factors in future models of pain research and treatment.

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