

**SPECIAL ISSUE ON CENTRAL SENSITIZATION**

# Central sensitization and the biopsychosocial approach to understanding pain

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Medical interventions alone have been largely unsuccessful in treating and curing disorders characterized by chronic pain like central sensitivity syndromes (CSS; e.g., fibromyalgia, chronic migraine, temporomandibular disorders, irritable bowel syndrome). In this article, we discuss how a biopsychosocial perspective adds to understanding people's experiences with chronic pain. A biopsychosocial perspective examines how biological, psychological, social, and contextual factors work independently and jointly to influence the experience, maintenance, and exacerbation of CSS and their symptoms. We highlight several key psychological and social factors relevant to many people who live with CSS, while also emphasizing the heterogeneity in people's experiences, life courses, and symptoms. Furthermore, we emphasize that the psychological, social, and contextual factors that we include are best characterized as contributors to chronic pain experience rather than causes of it.

## 1 | INTRODUCTION

Data from the 2012 National Health Interview Survey indicate that 126.1 million adults (56%) reported "some" pain in the previous 3 months, including 25.3 million adults (11.2%) reporting the experience of daily pain, another 23.4 million (10%) reporting "a lot" of pain, and 8 million living with pain severe enough to interfere with their lives (Nahin, 2015). International epidemiological studies estimate that over 20% of all adults experience persistent pain, with 10% newly diagnosed each year (Elzahaf, Tashani, Unsworth, & Johnson, 2012; Goldberg & McGee, 2011). Children and adolescents also experience chronic pain with international estimates ranging from 11% to 38% of the population (King et al., 2011), and 5% to 8% experiencing severe or disabling pain such that they

are unable to attend school, maintain social relationships, exercise, or participate in activities with their families (Gold, Mahrer, Yee, & Palermo, 2009; Huguét & Miró, 2008). Thus, chronic pain is a major public health problem. Nationally, chronic pain conditions have an immense economic impact. Prior appraisals of annual costs emerging from these conditions range from \$560 to \$635 billion, and include direct costs of medical care, along with indirect costs such as lost wages and productivity (Gaskin & Richard, 2012). Notably, these costs surpass those of other high-impact diseases such as cancer, heart disease, and diabetes (Institute of Medicine (US) Committee on Advancing Pain Research, Care, and Education, 2011). The total direct cost of moderate–severe pediatric chronic pain in the United States is estimated to cost another \$19.5 billion/year (Groenewald, Essner, Wright, Fesinmeyer, & Palermo, 2014). Beyond the economic impact of chronic pain, these conditions affect the everyday lives of individuals, their families, and communities. Chronic pain is associated with disability, reduced quality of life, and heightened risk for depression (Flor & Turk, 2011).

Central sensitivity syndromes (CSS) account for a significant proportion of the class of chronic pain conditions (Woolf, 2011). Central sensitization (CS) is defined as an amplified response and/or increased responsivity of nociceptive (pain) neurons in the central nervous system to sensory stimuli (Woolf, 2011; Yunus, 2007). Within the past decade, a number of common chronic pain conditions, historically viewed as independent, have been included under the rubric of CSS due to their overlapping features. Some examples of the many conditions that have been included within the CSS classification are fibromyalgia (FM), chronic fatigue syndrome, irritable bowel syndrome (IBS), chronic pelvic pain, temporomandibular joint disorder, and migraine (Yunus, 2007, 2015). It is important to acknowledge that although CSSs share a number of common features, the sets of symptoms and severity of specific symptoms vary, and thus it would be a mistake to lose sight of the differences across these disorders as we focus on the similarities (Adams & Turk, 2015). For example, not all of those diagnosed with IBS meet the criteria for FM, and although some with migraines report widespread pain, others do not (e.g., Okifuji, Turk, & Marcus, 1999). Moreover, even those with the diagnosis of FM may not share all sets of symptoms (Wilson, Robinson, & Turk, 2009) or patterns of location of pain site even though they experience widespread pain overall (Wilson et al., 2009).

The underlying etiology and pathophysiology of CSSs are incompletely understood at this time (Woolf, 2011); however, as the name suggests, CS is viewed as primarily occurring in the central nervous system. It is proposed that peripheral nerves function normally, whereas disruptions in normal functioning occur in the central neurons of the spinal cord and brain. Hypersensitized central neurons have been demonstrated to consist of reduced firing thresholds, expanded receptive areas, prolonged stimulus-independent activity, and potentiated responses relative to typical central neurons (Baron, Hans, & Dickenson, 2013; Latremoliere & Woolf, 2009). Indeed, individuals with CS show heightened pain sensitivity (hyperalgesia) and diffusion of pain (secondary hyperalgesia), along with lowered pain thresholds (allodynia). In fact, thresholds can be lowered to such an extent that pain can be experienced even in the absence of identified nociceptive stimuli (Woolf, 2011). Clinically, this can manifest as a patient who reports pain being widespread and present in multiple body regions or pain occurring after activities that are generally viewed as mundane and painless (e.g., taking a short walk or cooking a meal). In a sense, CSS appears to have some overlap with discussion of somatic amplification described as a tendency to perceive normal somatic and visceral sensations as being relatively intense, disturbing, and noxious (Barsky, 1992). It is, however, unclear whether persons with somatic amplification have a truly increased physiological sensitivity to bodily sensations as suggested by proponents of CS versus a subjective perception characterized by a lower threshold associated with cognitive processing of stimuli.

To date, individuals with CSS (and other pain conditions) are treated with interventions that are palliative, rather than curative. Individuals with CS often report negative experiences when seeking care and support for their “invisible” conditions, ranging from skepticism to complete disbelief (De Ruddere & Craig, 2016; Newton, Southall, Raphael, Ashford, & LeMarchand, 2013). These negative reactions are directed by friends, family, and health-care providers alike. In the face of incomplete information about the causes and the absence of a curative treatment (“magic bullet”) for CSS and chronic pain, the best course of action to help people with CSS

manage their symptoms and enhance their quality of life must include a comprehensive approach that addresses all domains of their lives—physical, emotional, and social functioning. In this paper, we suggest that CSSs offer an opportunity to examine the utility of the biopsychosocial perspective in understanding the lived experiences of people with chronic pain (Flor & Turk, 2011; Gatchel, Peng, Peters, Fuchs, & Turk, 2007). Furthermore, we believe that by taking into account the many, overlapping influences on our daily lives—including the experience, maintenance, and exacerbation of chronic pain for those who live with it—the biopsychosocial model aids in the conceptualization and treatment of CSS.

## 2 | THE BIOPSYCHOSOCIAL PERSPECTIVE ON PAIN

Historical views on chronic pain have, at best, provided an incomplete understanding of pain and, at worst, an inaccurate depiction of the pain process. Traditional Western perspectives on pain have focused exclusively on biomedical causes, assuming a direct, linear relationship between sensation, tissue pathology, and pain experience (Flor & Turk, 2011). The natural conclusions that follow such a conceptualization highlight the inadequacies inherent in this model. According to this approach, all reports of pain should have an underlying physiological cause; however, medical providers can attest to the vast numbers of patients who defy this assumption by reporting persistent pain even after undergoing laboratory and imaging evaluations that produce negative results. Over 30 years ago, Deyo (1986) observed that as many as 86% of individuals who report back pain, a very prevalent disorder, reveal no evidence of objective pathology. Despite advances in knowledge of neurophysiology and advanced imaging technologies, the pathophysiology for back pain remains an enigma (Koes, van Tulder, & Thomas, 2006; Lee et al., 2015).

The biomedical model also fails to account for other commonly encountered pain-related phenomena: people who experience ostensibly pain-inducing events may not report significant pain (e.g., Carragee, Alamin, & Carragee, 2006; Dunn et al., 2014). Conversely, people reporting severe pain may have few objective markers consistent with the report of pain (e.g., Lee et al., 2015). Thus, there appears to be a discordance between objective tests and pain reports and impact on functioning across such diverse disorders as back pain (Brinjikji et al., 2015; Lee et al., 2015), whiplash (e.g., traumatic injuries; Sarrami, Armstrong, Naylor, & Harris, 2017), and knee osteoarthritis (OA) (e.g., disease-related; Finan et al., 2013; Thomas et al., 2008). Furthermore, identical surgical treatments may produce diverse reports of pain severity across individuals (e.g., Gerbershagen et al., 2013) and treatments targeting the same symptoms may have differing effectiveness across people with the same diagnosis (Rusu, Boersma, & Turk, 2012). Despite the outlined weaknesses of the biomedical model, it remains a widely held view of the lay public and health-care providers alike, and has an appreciable impact on the experiences of people diagnosed with CSS who seek a physiological explanation for their symptoms as well as a cure.

We posit that the biopsychosocial perspective provides a better means of understanding and treating CSS and chronic pain than a singular biomedical (or psychological or social) approach. Individuals actively process information regarding internal stimuli and environmental events. Using general information-processing strategies as well as their unique learning histories and emotion-regulation strategies, individuals make judgments about the meaning of sensory and external events and develop expectations concerning the consequences they will experience following different responses to those events. These expectations, in turn, influence individuals' pain-related responses.

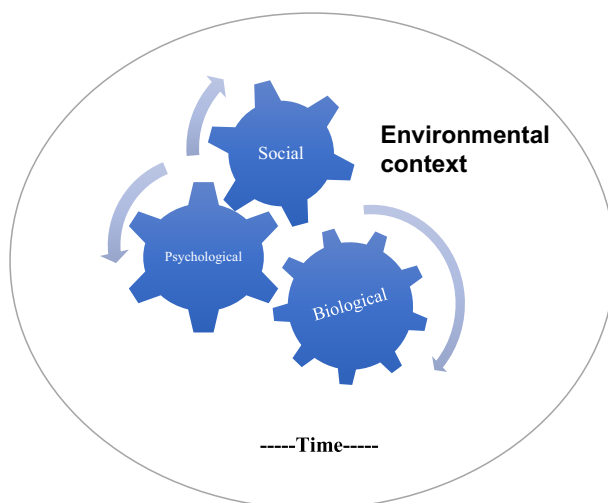
The biopsychosocial approach considers pain and pain-related behavior to be the result of the interplay among biological, psychological, social, and contextual factors. Given that pain is viewed as emanating from these interactive and synergistic factors, the biopsychosocial model also assumes that effective pain treatment must incorporate aspects of each of these components (Flor & Turk, 2011; Gatchel et al., 2007). Assessment must then, be comprehensive considering a broad array of predisposing, initiating, maintaining, and exacerbating components of pain.

The biopsychosocial approach allows a nuanced view of pain. We believe that there are three key considerations intrinsic to this nuanced view of people who experience chronic pain: (1) pain is a dynamic process, (2) pain experiences are unique to each individual, and (3) there is a difference between contributing factors and causes of pain. Throughout reading this article, we hope that each of these considerations remains at the forefront of the reader's mind in order to avoid mischaracterizing the biopsychosocial model or the experiences of people with CSS and chronic pain.

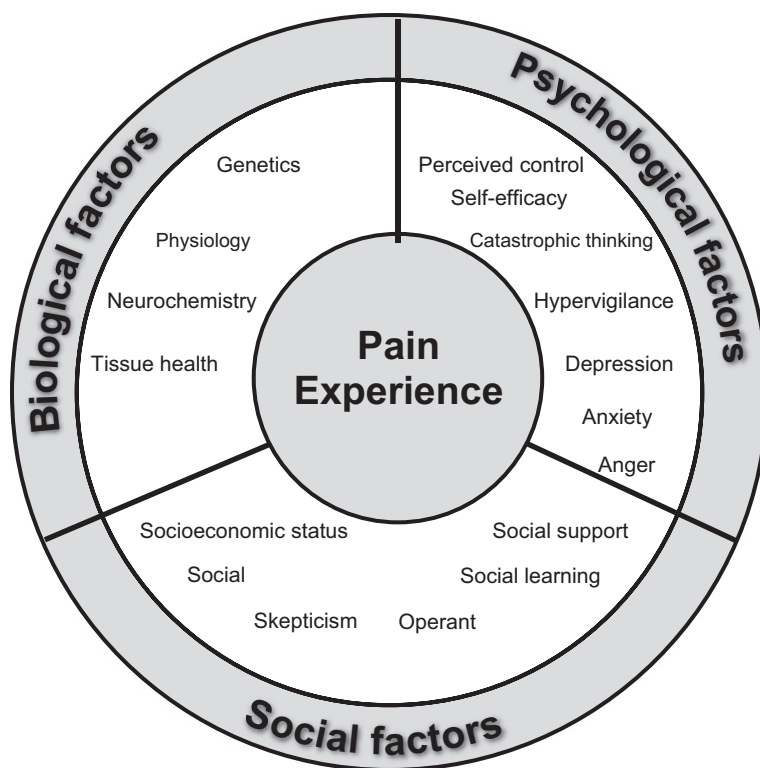
Pain is not a static experience—it changes over time as symptoms ebb and flow and as a person's adjustment to it evolves. It is the rare person, regardless of the class of chronic pain, who reports stable levels of pain intensity. The biopsychosocial model is not a static approach (Figure 1). The model allows for a dynamic view of pain, taking into account the various biological, psychological, and social factors that evolve throughout a person's lifetime—those that preceded as well as follow symptom onset (George et al., 2008). Factors may change independently (e.g., a change in psychological health), but due to the interconnections among domains, a change in one factor will likely impact the others.

Pain and experiences associated with it are unique to each person. Although there are common features of pain and of CSSs, people who experience these issues represent a diverse group, both across CSS conditions and within them (Okifuji et al., 1999; Wilson et al., 2009). By definition, the biopsychosocial model recognizes the inherent heterogeneity accompanying living with chronic pain. Each individual has an idiosyncratic genotype and life history, with different life circumstances, perturbations, and opportunities, which interact to instigate a person's response to chronic pain at any point in time. Thus, while we highlight a number of common psychological and social factors in chronic pain, we urge the reader to recognize that these factors may be relevant for some people some of the time, less relevant for others, and that the weight of importance of each factor may vary within and across people over time.

Emphasizing the distinction between contributors to and causes of pain is perhaps one of the most important tasks when discussing pain from a biopsychosocial perspective. In the remainder of this article, we discuss some psychological and social factors that *influence* (amplify as well as inhibit the perception of potentially noxious sensory information) the ways that people with CSS experience their illnesses (Figure 2). However, we do not implicate psychological or social factors as direct *causes* of symptoms because there is little empirical evidence to support this perspective. Even in cases in which symptoms occur following a psychological or social disruption, there is no evidence that any single psychosocial factor or set of factors is or are the sole cause(s) of CSS (Hassett



**FIGURE 1** The dynamic biopsychosocial model



**FIGURE 2** Biopsychosocial model of pain

& Clauw, 2011). Likewise, many people who experience comparable phenomena do not develop specific symptoms or a CSS. Taken together, this reinforces the importance of maintaining an individualistic view when applying the biopsychosocial model to a *person's* pain experience. Living with chronic pain is a significant challenge, and it is vital to understand how psychological and social factors interact with biological ones to perpetuate and amplify symptoms associated with CSS.

## 2.1 | Criticisms of the biopsychosocial perspective

The biopsychosocial model is not without its critics, and before discussing psychological and social factors relevant to pain in detail, we address the most frequent issues raised. The biopsychosocial model has been critiqued for being too broad in nature, lacking a scientific method to operationalize and test, and for generally being unhelpful given that it does not specify which interventions to focus on for treatment (Freudenreich, Kontos, & Querques, 2010; Ghaemi, 2009). We emphasize that the biopsychosocial approach is meant to be a framework that extends the scope of influences on pain beyond just biomedical ones, but not to the exclusion of them. Such a blanket declaration would lie in opposition to an important underlying premise of the biopsychosocial perspective—that an individual's genotype, history, experiences, and resources work together with biological ones to influence their pain experience. Rather than provide a proscriptive guide, the biopsychosocial approach calls for a fuller picture of the *person* behind the pain report. The biopsychosocial model has also been criticized for overemphasizing psychosocial factors and minimizing the important contributions of biomedical ones (Turk & Robinson, in press). This emphasis on the psychological component of the model may serve to stigmatize and pathologize the experiences of people with chronic pain and attribute excessive blame on significant others for the quality or absence of appropriate support. Although the relationships between

factors and the relative influence of any given domain may change depending on the person and time, the biopsychosocial approach is compromised when any one of the components—biological, psychological, social, or contextual—is excluded.

### 3 | PSYCHOLOGICAL ASPECTS OF PAIN

People's appraisals of their circumstances and emotions affect their expectations, responses, and consequently their actual experiences. Every aspect of a person's existence is filtered through his or her own interpretations based on prior experiences. It is difficult, if not impossible, to fully communicate one's experience of pain to another person. This challenge is evident in the many attempts to operationalize, quantify, and assess pain throughout the literature and the complexities observed (e.g., Jensen, Johnson, Gertz, Galer, & Gammaitoni, 2013; Myles & Christelis, 2011). Asking a person to rate the severity of their average pain on a 0–10 scale or using simple verbal descriptors such as mild, moderate, or severe is a complex process of interpretation that involves decision-making and an individual's communicative style. Consider the request for you to rate your average level of fatigue over the past week. How would you arrive at an estimate? Arriving at an answer is not a simple task; your response is affected by a range of factors including your current mood state and context that may serve as anchors to your current decision and estimate.

Imagine an individual who awakens one morning with a headache. His first thought might be to seek a cause to attribute the symptoms, e.g., "It's because I had too much to drink at the party last night." This explanation might lead him to a sense of annoyance with himself for having consumed too much alcohol, and then decide to take two aspirin and to lie down for a while before getting up for the day's activities. It may even lead him to cut back on his alcohol consumption in the future. Now consider the same individual, who experiences the same noxious sensations and headache, who decides that the symptoms remind him of those his father described just before he died from a brain aneurysm. Given this latter interpretation, one might expect a significant increase in the interpreter's emotional arousal that might serve as an impetus for him to go immediately to the emergency department at his local hospital. Same symptom, different interpretation, different degrees of emotional arousal, and different behaviors and outcomes (rapid resolution of symptoms vs. receiving diagnostic tests and costly hospital bills). The pain experience is both mediated and moderated by a person's cognitive processes and affective states, both of which contribute to behavioral responses and outcomes as illustrated in the case of the man awakening with the headache. We can now consider some of these cognitive and affective mediators and moderators that are involved in the perception, experience, and response to noxious sensory input.

### 4 | COGNITIVE ASPECTS OF PAIN

#### 4.1 | Perceived control

Developing a reasonable sense of control over one's symptoms and pain experience can significantly improve an individual's functioning. In general, extant research supports the idea that individuals who endorse a greater sense of control over their symptoms and symptom management function better (Arntz & Schmidt, 1989). A variety of studies have demonstrated that people who take an active approach in managing their pain (e.g., problem solving, positive thinking, relaxation, physical activity) report less interference in their daily lives from pain (e.g., Turk & Okifuji, 2002; Turner, Jensen, & Romano, 2000). Conversely, those with low perceived control and who consider themselves as being helpless generally report worse outcomes (e.g., Burns, Johnson, Mahoney, Devine, & Pawl, 1998; Nielson & Jensen, 2004; Wells, 1994). However, the relationship between perceived control and pain-related outcomes is more complex than originally conceptualized. Perceptions of control and actual control

are not equivalent. Being able to differentiate between these two aspects of control is particularly important for those with chronic pain. Emerging evidence suggests that when actual control is low, repeated attempts to control or eliminate symptoms may reinforce catastrophic thinking, worry, and other unhelpful approaches such as seeking further health care consultations, diagnostic tests, and treatments (McCracken & Vowles, 2006). Instead, it appears that a key to successful CSS and chronic pain management lies in finding the appropriate balance between managing that which is within a person's control (e.g., exercise, sleep hygiene) and that which may exist outside of their control (e.g., financial circumstances, genetic predisposition, physical impairments).

## 4.2 | Self-efficacy

Moving a step beyond whether a person believes that they can exert an influence on an outcome (perceived control), self-efficacy refers to the extent to which they believe that they have the skills and resources needed to accomplish some objective (Bandura, 1977). Self-efficacy plays a major role in an individuals' thoughts, feelings, and behaviors, and influences how people cope with challenging situations, such as symptoms. Converging lines of evidence indicate that perceived self-efficacy operates as an important cognitive factor in adaptive psychological functioning (e.g., Benyon, Hill, Zadurian, & Mallen, 2010; Jensen, Turner, & Romano, 2007; Sardá, Nicholas, Asghari, & Pimenta, 2009), disability (e.g., Benyon et al., 2010; Burke, Mathias, & Denson, 2015; Busch, Göransson, & Melin, 2007; Sardá et al., 2009), and treatment outcome (e.g., Huffman, Pieper, Hall, St Clair, & Kraus, 2015; Jensen et al., 2007).

Feelings of low control and helplessness have been shown to predict work disability in patients with rheumatoid arthritis over the course of 7 years (Odegård, Finset, Kvien, Mowinckel, & Uhlig, 2005), explains impaired physical and psychological quality of life (Lu, Lin, Lin, & Lin, 2008), and predicts outcome of joint replacement surgery in patients with OA of the hip (Gandhi, Razak, Tso, Davey, & Mahomed, 2009). Efforts to increase patients' self-efficacy demonstrate that this objective is not only possible, but can influence successful outcomes. A meta-analysis of 46 RCTs of cognitive-behavioral therapy (CBT) for low back pain found that when compared to wait-list controls, CBT increased self-efficacy regarding pain control, ability to function physically, along with reduction in depression, anxiety, and stress, and improvements in general quality of life. The treatment also reduced health-care visits, reduction in work days lost, and higher likelihood of return to work (Sveinsdottir, Eriksen, & Reme, 2012). For example, among a group of cognitive and affective mediators of improvements in pain and disability among patients with persistent orofacial pain, self-efficacy emerged as the strongest predictor of outcomes (Turner, Holtzman, & Mancl, 2007). In sum, research not only suggests that high baseline self-efficacy for pain control is associated with better outcomes for people with chronic pain but also that improvements in self-efficacy for pain management can result in better pain control (Asghari & Nicholas, 2001).

It is important to note that self-efficacy is not a global trait—it is bound and defined by specific activities. For example, a young woman with chronic migraines may have high self-efficacy for completing demanding tasks at work, but low self-efficacy for managing her migraine symptoms. Perceived self-efficacy is a state that may change depending on circumstances encountered. As such, in order to understand a person's pain experience, one must identify the domains in which self-efficacy are relevant for that person (e.g., exercise, drawing upon social support, seeking medical intervention).

## 4.3 | Catastrophic thinking

Catastrophic thinking, or an expectation that the worst possible outcome will occur in a given situation, is a particularly maladaptive thinking style (Quartana, Campbell, & Edwards, 2009). Its impact on pain experience has been researched extensively. For example, drawing from a nationally representative sample of U.S. adults with chronic pain by means of random digit dialing procedures, Karoly, Ruehlman, and Okun (2013) found that continued employment, in contrast to being on disability, was negatively related to a belief in a medical cure for pain and

to the tendency to catastrophize. Attitudes reflecting task persistence (e.g., “I do not let my pain get in the way of what I want to do”) positively predicted continued employment.

A wide variety of methodologies (experimental, case-controlled cohort, longitudinal, cross-sectional) have demonstrated a relationship between catastrophic thinking and measures of pain, psychological disability, physical disability, and gait velocity in patients with OA, response to surgery in the immediate post-operative period (Roth, Tripp, Harrison, Sullivan, & Carson, 2007), as well as at 1-year follow-up (e.g., Riddle, Wade, Jiranek, & Kong, 2010; Sullivan et al., 2009), worsened pain experience overall (e.g., Arnow et al., 2011; Theunissen, Peters, Bruce, Gramke, & Marcus, 2012), and disability following traumatic injury (Sarrami et al., 2017). Furthermore, reductions in catastrophic thinking have been associated with symptom improvement (Smeets, Vlaeyen, Kester, & Knottnerus, 2006; Weissman-Fogel, Sprecher, & Pud, 2008).

The mediating effects of pain catastrophizing have been examined with patients receiving only physical therapy, only CBT, or a multidisciplinary therapy combining both treatments (Smeets et al., 2006). Results demonstrated that pretreatment to posttreatment reductions in catastrophizing significantly mediated improvements in measures of disability, patient-specific symptoms, and pain severity across all three treatment modalities. Other studies have also found that reductions in pain catastrophizing mediated improvement in depression and pain behaviors, and partially mediated improvements in activity tolerance among patients enrolled in an interdisciplinary pain treatment program (Spinhoven et al., 2004). Cross-lagged analysis has been utilized to examine temporal sequencing of change in catastrophizing relative to outcome among patients receiving 4 weeks of multidisciplinary pain rehabilitation treatment. Results showed that early treatment (i.e., pretreatment to mid-treatment) reductions in pain catastrophizing predicted late treatment (i.e., mid-treatment to posttreatment) improvements in pain outcome, providing a stronger causal argument for pain catastrophizing as a process variable that accounts for improvement in outcome in multidisciplinary pain management treatment settings (Burns, Glenn, Bruehl, Harden, & Lofland, 2003).

#### 4.4 | Hypervigilance

People with CSS often develop a pattern of behavior in which they are constantly hyperalert for future or worsened pain. Hypervigilance for pain has been associated with increased pain intensity, duration, disability, avoidance of activities, and more frequent pain-related health-care utilization (Crombez, Eccleston, Van den Broeck, Goubert, & Van Houdenhove, 2004; Parr et al., 2012). Although remaining highly vigilant for threatening information may be easily viewed as an unhelpful practice among people without chronic pain, it is important to recognize that it makes sense to those who deal with pain on a consistent basis. Indeed, recognizing and responding to threatening information is critical for survival in the short-term. While people with CSS recognize this, the tendency to broaden this practice beyond monitoring symptoms to maintaining excessive focus on them functions to worsen pain. Hypervigilance is a central component of the Fear-Avoidance Model (FAM).

#### 4.5 | Fear avoidance

The negative impacts of catastrophizing and hypervigilance on pain occur within the context of what has been described as the FAM of pain (Crombez, Eccleston, Van Damme, Vlaeyen, & Karoly, 2012). According to the FAM, individuals' beliefs about the possibility of negative consequences of behavior prevent them from engaging in activities. For example, engaging in paced, physical activity has been shown to help alleviate pain. However, individuals who catastrophize about the potential for overexertion following physical activity or about the possibility of exacerbated pain following exercise may avoid the activity altogether. As a result, the person's anxiety levels remain constant, their catastrophic thinking remains intact, and they miss out on the opportunity to experience the positive impact of physical activity on pain symptoms. Notably, hypervigilance plays a similar role in setting the FAM into motion. Individuals who are hypervigilant about their pain are likely to cease activity at the first sign of symptoms—often before benefits (pain-related, social, or otherwise) of the activity can be conferred.



High levels of depression, anxiety, and fear-avoidance behaviors have been shown to be prognostic for poor recovery and poor outcomes following surgery (e.g., Alodaibi, Minick, & Fritz, 2013). For example, fear avoidance beliefs prior to surgery have been shown to predict pain and disability up to 6 months after spinal surgery for degenerative conditions (Archer, Seebach, Mathis, Riley, & Wegener, 2014), a significant prognostic factor for return to work in patients with sciatica (Grøvre et al., 2013), and moderators of treatment efficacy in patients with low back pain (Wertli et al., 2014). Overall, a meta-analysis of pain-related fear and disability reveals that pain-related fear and disability are associated at moderate to large magnitudes (Zale & Ditre, 2015; Zale, Lange, Fields, & Ditre, 2013). Activity restriction may serve to maintain anxiety and avoidance, and ultimately results in ongoing and worsening CSS symptoms.

Newer conceptualizations of the FAM of pain emphasize the importance of considering multiple pathways through which pain persistence and disability occur, rather than just through fear and avoidance (Pincus, Smeets, Simmonds, & Sullivan, 2010; Wideman et al., 2013). For example, people with chronic pain may not only avoid activity to avoid pain ("I don't want to hurt myself"), but they may also actively *approach* sedentary behaviors because they offer additional benefits or goals ("I just want to relax"). A biopsychosocial view of pain is flexible enough to consider how each of these thoughts contribute to a person's pain experience.

## 5 | EMOTIONAL ASPECTS OF PAIN

Emotional factors have been implicated in the experience of chronic pain (e.g., McWilliams, Cox, & Enns, 2003; Outcalt et al., 2015). It is important to make a distinction between psychological symptoms such as depressive symptoms and distressing mood and psychiatric diagnoses. Given the significant impact of persistent pain on all domains of functioning, it is hardly surprising that many individuals experience emotional distress; however, not all manifest as full psychiatric disorders. Both are important and need to be considered in CSS.

### 5.1 | Depression

Pain and depression co-occur with rates ranging from 30% to over 60% (Bair, Robinson, Katon, & Kroenke, 2003; Kroenke et al., 2011). These figures can be compared with the prevalence of depression in the general population of 5%–8% (Lollis, Marsh, Sowin, & Thompson, 2009) and to those having any underlying major illness with rates estimated to range between 10% and 20% (Rayner et al., 2010). In all of these instances, the prevalence of depression is substantially higher in people with chronic pain.

People with chronic pain, including CSS, often endorse considerable emotional distress as a result of their chronic pain, and evidence supports the notion that depression tends to emerge after the development of chronic pain (Poole, White, Blake, Murphy, & Bramwell, 2009). However, it would be incorrect to assume that this temporal order is fixed. Although the prevalence of depressive symptoms is higher in individuals diagnosed with chronic pain, the prevalence of chronic pain is also higher among individuals diagnosed with depression. In fact, longitudinal studies demonstrate that depression is a risk factor for the development of subsequent chronic pain (e.g., Carragee, Alamin, Miller, & Carragee, 2005; Jarvik et al., 2005). Depression is the most commonly reported psychiatric condition associated with chronic pain, and people with chronic pain are three times more likely to meet diagnostic criteria for depression than people without pain (Bair et al., 2003). Notably, these rates do not include the many individuals with chronic pain who do not meet full diagnostic criteria for major depression.

Consistent with a biopsychosocial perspective, depression is not only associated with rates of chronic pain but also with heightened pain intensity and duration during pain episodes, and is a significant determinant of pain-related disability and health-care utilization (Lerman, Rudich, Brill, Shalev, & Shahar, 2015; Steiner, Bigatti, Slaven, & Ang, 2017). Core symptoms of depression, including low mood and loss of interest in once

pleasurable activities (anhedonia), are associated with retreating from social support, disengaging from health protective activities, and a general decline in functioning. From a biological perspective, depression and physical pain are thought to arise from similar brain structures and regions (e.g., prefrontal cortex, anterior cingulate cortex, thalamus, hippocampus) and similar neurotransmitter abnormalities (Goesling, Clauw, & Hassett, 2013).

## 5.2 | Anxiety

Anxiety, like depression, is extremely prevalent in people with chronic pain (Bair, Wu, Damush, Sutherland, & Kroenke, 2008; McWilliams et al., 2003). In a meta-analysis of psychological functioning in chronic pain patients, Burke et al. (2015) found that although those with chronic pain were consistently more depressed than pain-free comparison groups, they were comparatively even more anxious, both in general and pain-related areas.

Given the incomplete picture of the etiology of CSS, it is understandable that people with these conditions are particularly vulnerable and often report worry and concern about their pain, and its impact on their futures. Taken to the extreme, excessive concern can manifest as an anxiety disorder. Rates of clinically significant anxiety are elevated among people with CSS and other chronic pain conditions. It is estimated that the prevalence of any anxiety disorder among people with chronic pain is double that of people without chronic pain (Bair et al., 2008). As is the case with depression, research supports a bidirectional relationship between anxiety and chronic pain. Anxiety contributes to heightened pain appraisals and reduced pain tolerance, and chronic pain contributes to a worse course of anxiety among individuals with anxiety disorders (Knaster, Karlsson, Estlander, & Kalso, 2012; Kroenke et al., 2013; Lerman et al., 2015).

## 5.3 | Anger

Like perceived control, anger appears to play a complex and nuanced role in the experience of chronic pain (Fernandez & Turk, 1995). People with CSS often report feelings of anger and frustration stemming from the direct and indirect effects of their pain. Anger is not a singular experience. It can be conceptualized as having several dimensions—the anger experience, anger expression, and the target of angry feelings. Although anger is often viewed in a negative light, it can be an adaptive response to a perceived slight or injustice. Rather than whether anger is experienced, how it is modulated (e.g., expressed, inhibited) appears to have a greater impact on individuals with chronic pain's symptoms and their functioning (Burns, Quartana, & Bruehl, 2008). People who express their anger through verbal and physical means are thought to have an endogenous opioid dysfunction, which results in increased responsiveness to painful stimuli, and it is also the case that muscle tension following anger arousal and expression exacerbates pain (Burns, 1997). On the contrary, inhibiting anger is also associated with increased pain and pain interference as individuals work to “bottle up” their anger. Inhibited anger expression is not only associated with worse pain-related outcomes, but also depression (Kerns, Rosenberg, & Jacob, 1994).

## 6 | SOCIAL ASPECTS OF PAIN

Although pain is a personal experience, people who live with it do not exist in vacuums. There are social and communal aspects of pain. People with CSS rarely suffer through their conditions in isolation, and how they experience their symptoms affects the lives of those around them. Furthermore, the social and societal circumstances that they find themselves in will invariably affect the lives of people living with chronic pain.

Pain thus has both a protective and communicative function. Since pain is a subjective state, the only way we can know about a person's pain is by what can be communicated verbally or behaviorally. "Pain behaviors" convey information about the experience of pain and associated emotional distress. Since behaviors are observable they are capable of eliciting responses from others and these responses (e.g., positive and negative reinforcers) can influence the perpetuation, amplification, and extinction of the behaviors emitted.

## 6.1 | Socioeconomic status

Socioeconomically disadvantaged individuals are more likely to develop pain conditions, and report more severe pain and disability than middle- and high-socioeconomic status individuals (Green & Hart-Johnson, 2012; Grol-Prokopczyk, 2017; Janevic, McLaughlin, Heapy, Thacker, & Piette, 2017). These individuals are also more likely to report that pain significantly interferes with their daily lives. In a daily diary study of 250 women with OA, FM, or both, economic hardship was associated with greater pain severity on days when they experienced financial worries; women who reported the highest levels of economic hardship demonstrated the most pain reactivity in response to financial worries (Rios & Zautra, 2011). Financial constraints and limited access to health care can act as significant barriers to pain management, and can, in turn, negatively impact other areas of life. For example, without access to treatment that can reduce (rarely eliminate) CSS symptoms, individuals may have difficulty staying employed or in school.

## 6.2 | Social stigma and skepticism

Individuals with CSS frequently report that others' stigmatizing attitudes have a negative effect on their lives (Armentor, 2017; Looper & Kirmayer, 2004). Stigma is defined as a set of negative characteristics that distinguish a person as different and separate from a normative group (Goffman, 1986). Stigma has the function of devaluing and discrediting a person's identity and/or experiences, and can have a negative impact on one's psychological well-being and on their relationships with others. Stigma can lead to decreased self-esteem and higher rates of depression. Several processes by which stigma affects self-esteem and dignity have been described (De Ruddere & Craig, 2016). To the extent that stigma is internalized, lack of a clear etiology for their pain may make CSS patients skeptical about the credibility of their symptoms and cast doubts about their condition.

Many people with CSS implicate romantic partners, friends, relatives, and even health-care providers as sources of stigma (Looper & Kirmayer, 2004). Close friends and family members may not fully understand CSS, and may be confused by the seemingly random ebb and flow of symptoms, along with the lack of observable markers of illness. Patients with CSS frequently discuss being "left out" of activities with friends and family as a result of their symptoms. Even though these exclusions may be meant to help preserve a person's energy and health, they have the stigmatizing effect of distancing the person with chronic pain from others.

Studies have shown that health care providers, including physicians, medical students, nurses, and nursing students attribute lower pain to patients when their pain does not have a clear etiology and have more negative feelings about such patients (e.g., less sympathy, greater dislike, less inclined to help; Chibnall, Tait, & Ross, 1997; De Ruddere & Craig, 2016; De Ruddere et al., 2014). As such, providers may seriously invalidate the experiences of people with CSS. This invalidation may not only have a detrimental effect on the psychological well-being of the person, but may have a realized effect on their symptoms. For example, if a health-care provider does not believe that a person is experiencing chronic pain, they may be less inclined to seek and prescribe treatments for the condition. Even in instances in which providers do not intend to stigmatize their patients, providers' uncertainty about how to proceed with care may be perceived and experienced as hostile, blaming, or as disbelief. In these circumstances, considering additional factors that may play a role in these interactions can help identify pathways to improve a person's pain experience.

### 6.3 | Social learning and operant conditioning

The idiographic biopsychosocial approach to pain is demonstrated well by the social learning perspective. This perspective offers a framework for understanding how CSS pain and symptom behaviors (e.g., actions, verbalizations) develop, are reinforced, and maintained over time (Fordyce, 1976; Goubert, Vlaeyen, Crombez, & Craig, 2011). According to the social learning perspective, a person's entire learning history, including the sum of responses that their behavior evokes from others, guides their behavior. Consistent with Thorndike's law of effect, behaviors that result in pleasant outcomes (positive reinforcement) or the removal of negative outcomes (negative reinforcement) are maintained, while behaviors that result in negative outcomes (positive punishment) or the removal of positive outcomes (negative punishment) are terminated (Thorndike, 1927).

How significant others respond to individuals with chronic pain can have significant implications on mood as well as behavioral responses. Following from operant theory, providing attention for expressions of pain, distress, or suffering may positively reinforce those behaviors and thereby increase the likelihood that they will be maintained and repeated. Maladaptive pain behaviors may also be maintained by promoting escape from noxious stimulation through the use of drugs or rest, or avoidance of undesirable activities such as work. Conversely, failure to provide positive reinforcement such as encouragement for the maintenance of activity despite pain may result in reduced levels of activity, and experiencing pain after activity may also decrease the performance of those activities in the future.

Importantly, these effects of reinforcement need not even be apparent or conscious to be produced and may generalize to similar situations beyond those in which the original reinforcement may have occurred. That is, they become conditioned by the consequences they engender or that are anticipated. A number of studies have provided evidence that supports the underlying assumptions of the operant conditioning model (e.g., Jolliffe & Nicholas, 2004). Likewise, a number of studies have demonstrated the effectiveness of treatments based on operant principles (e.g., Henschke et al., 2010).

The social-learning perspective takes a life-span approach, and begins in childhood. With regard to pain and health, children learn about symptoms of pain, along with appropriate and inappropriate responses to pain from their parents, peers, cultural influences, and the broader society. Over time, symptom-related behaviors that result in positive rewards are maintained in one's behavioral repertoire, while others that have resulted in negative outcomes (e.g., criticism, rejection) are removed. Naturally, such a view of pain behavior requires that a person's unique history is examined. For example, one person with CSS may openly discuss their pain with anyone who will listen, having learned that people will offer assistance, while another person may remain stoic after having learned that people may shun them for "excessive complaining." It is important to note that people with chronic pain do not necessarily engage in this type of behavior with malicious intent or to be manipulative. Instead, the person is exhibiting an expected pattern of behavior based on their experiences, which may include maladaptive components. Although we discuss this pattern of responses with regard to pain behavior in this article, any number of learned responses could be substituted and may be applicable to the reader's experience!

### 6.4 | Social support

The literature is filled with studies examining the role of social support in health outcomes. Studies suggest that perceptions of social support play a more important role than receipt of actual social support (Cano & de Williams, 2010). Social support can have a positive influence on pain symptoms via several routes—people may learn new strategies to manage CSS from others and individuals may effectively capitalize upon their social networks to express frustration and solicit assistance. While the majority of evidence suggests that social support is associated with less pain, less distress, and better overall adjustment to CSS, not all studies have come to the same conclusion (Cano & de Williams, 2010).

Additional work has found that the type of social support that a person has access to matters. For example, when social support results in increased attention on negative aspects of pain or when it results in reinforcing pain behaviors, it can have a negative impact on pain symptoms and experience (Romano, Jensen, Turner, Good, & Hops, 2000). With the rise of social media, more individuals with CSS are seeking social support online. Online support groups offer convenience, anonymity, and a shared community of others with CSS (Turner, 2017). However, some online support groups may be less desirable as anonymity can offer hiding for rude, negative comments, misinformation can be spread across members, and content can be hyperfocused on negative aspects of living with pain.

## 7 | CONCLUDING THOUGHTS

Central sensitivity syndromes and chronic pain are influenced by and influence our physiology, our cognitive, affective, and behavioral reactions, our social realities, and the contexts in which they occur. The biopsychosocial model highlights these multiple moving parts, and emphasizes the patterns and unique aspects of living with chronic pain. Failure to recognize a component of this model results in a failure to understand a person's pain experience. Thus, we again caution against conceptualizations that only or overemphasize the psychological or biological factors in pain. Moreover, it is important to not only focus on the commonalities across CSSs but also the heterogeneity both within and between the various, specific diagnostic groups (e.g., FM, IBS, pelvic pain syndromes). While it may be true that the biopsychosocial perspective is expansive, the complexity of CSS and people's lived experiences call for a multifaceted perspective, and accompanying assessment and treatment.

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