The Role of Psychosocial Processes in the Development and Maintenance of Chronic Pain

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Abstract: The recently proposed Analgesic, Anesthetic, and Addiction Clinical Trial Translations, Innovations, Opportunities, and Networks (ACTTION)-American Pain Society (APS) Pain Taxonomy (AAPT) provides an evidence-based, multidimensional, chronic pain classification system. Psychosocial factors play a crucial role within several dimensions of the taxonomy. In this article, we discuss the evaluation of psychosocial factors that influence the diagnosis and trajectory of chronic pain disorders. We review studies in individuals with a variety of persistent pain conditions, and describe evidence that psychosocial variables play key roles in conferring risk for the development of pain, in shaping long-term pain-related adjustment, and in modulating pain treatment outcomes. We consider “general” psychosocial variables such as negative affect, childhood trauma, and social support, as well as “pain-specific” psychosocial variables that include pain-related catastrophizing, self-efficacy for managing pain, and pain-related coping. Collectively, the complexity and profound variability in chronic pain highlights the need to better understand the multidimensional array of interacting forces that determine the trajectory of chronic pain conditions.

Perspective: The AAPT is an evidence-based chronic pain classification system in which psychosocial concepts and processes are essential in understanding the development of chronic pain and its effects. In this article we review psychosocial processes that influence the onset, exacerbation, and maintenance of chronic pain disorders.

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Persistent pain is a significant therapeutic challenge and a public health epidemic placing burdens on those experiencing pain as well as society more broadly. A survey of 10 developed and 7 developing countries suggests that the point prevalence of chronic pain among adults is 41% and 37%, respectively, figures which encompass a wide array of diverse conditions. In the United States, chronic pain is estimated to affect over 100 million adults at any given time, is among the leading causes of reduced quality of life, and carries direct and indirect costs of over $600 billion dollars annually in the United States alone.24 Moreover, the experience of persistent pain starts early; as many as 38% of children and adolescents in community samples report the presence of chronic pain.121 Despite the widely recognized effect of chronic pain on global health,
however, pain science continues to lack a precise, evidence-based taxonomy of chronic pain conditions, which would facilitate improvements in diagnosis and treatment.65

The Analgesic, Anesthetic, and Addiction Clinical Trial Translations Innovations Opportunities and Networks (ACTTION) public-private partnership with the U.S. Food and Drug Administration, and the American Pain Society have joined together to develop an evidence-based chronic pain classification system termed the ACTTION-American Pain Society Pain Taxonomy (AAPT). As noted in the initial description of the taxonomy, pain management stands to benefit substantially from the development of an empirically-based classification system that can serve to illuminate individual differences in the pain experience, inform policy, clarify prognosis, and guide treatment decisions.65 The structuring of the AAPT was on the basis of a consensus decision that the dimension along which pain disorders would be categorized is organ system/anatomical structure, which includes: peripheral and central neuropathic pain, musculoskeletal pain, pelvic/urogenital, visceral pain, and disease-related pains not classified elsewhere (eg, pain associated with active cancer, sickle cell disease, and Parkinson disease). Some of the most important characteristics of the taxonomy are that 1) it be on the basis of the best available evidence rather than solely on consensus or expert opinion, 2) the diagnostic criteria for specific chronic pain disorders should be determined using existing mechanistic and diagnostic evidence, rather than historical precedent or theoretical biases, 3) it reflects the multidimensional and biopsychosocial nature of chronic pain, and 4) it emphasizes the inclusion of existing information regarding mechanistic features and risk factors for pain conditions, including not only neurobiological but also psychosocial processes.65

In addition to establishing core diagnostic criteria for numerous chronic pain conditions (dimension 1), the AAPT provides dimensions on which to categorize common features and comorbidities of the conditions (dimensions 2 and 3), as well as detailing the consequences (dimension 4), and contributory mechanisms (dimension 5) of persistent pain disorders. A number of these identified features, consequences, and mechanisms are psychosocial in nature. Indeed, processes such as mood, affect (negative and positive), coping, and social support are included in the taxonomy as specific examples of risk factors, protective factors, or comorbidities that affect the experience of chronic pain and its presentation.65 The purpose of this article is to highlight the contributory role of psychosocial factors (eg, their function as risk factors, protective factors, or moderators) in the context of the AAPT classification system. The present review is one of a series of foundational supporting articles intended to highlight and describe crucial areas that are common to many or all of the conditions within the AAPT taxonomy. The process of psychosocial assessment (eg, conceptualization of psychosocial domains, evaluation and selection of assessment instruments) is addressed in a complementary supporting article in this Supplement to The Journal of Pain.62; to avoid redundancy, in this article we focus specifically on the understanding of the role of psychosocial processes in shaping the development and trajectory of pain conditions. It is also important to note that although the AAPT taxonomy is in many ways a typical category-based diagnostic taxonomy, most of the psychosocial processes described in this article, which have important roles in shaping the development and trajectory of chronic pain conditions, are best considered as continuous, dimensional variables rather than as categorical designations.

One additional important consideration: although the AAPT describes “psychosocial mechanisms” as part of dimension 5, we have endeavored to limit the use of the term “mechanism” because of some well-known limitations of the existing literature.18,103,112,125 In particular, for a process to function as a causal mechanism, it must be fully distinct from its effect and must clearly precede that effect in time. The literature in this area, although rich in suggestive associations between psychosocial constructs and pain-related outcomes, is impeded by substantial conceptual and theoretical overlap of constructs, as well as overlap in the methods by which they are measured (ie, usually by self-report on numerically scaled questionnaires), and from a relative dearth of clear prospective studies. That is, many of the findings that identify putative psychosocial mechanisms are on the basis of respondent recall of past events or states, or on mediational analysis of cross-sectional data, the limitations of which we elaborate in the Evaluating Psychosocial Contributions to Chronic Pain Outcomes section.

The Biopsychosocial Model of Pain

Before the 1960s, most people viewed chronic pain conditions as primarily medical issues with clear pathophysiological bases that required physical treatments such as surgery or medication.103 Subsequently, a biopsychosocial understanding has come to dominate the professional scientific community’s characterization of chronic pain. Collectively, the biopsychosocial approach describes pain and disability as a multidimensional, dynamic interaction among physiological, psychological, and social factors that reciprocally influence each other, resulting in chronic and complex pain syndromes.73,103 The overlap between affective disturbance and chronic pain has been widely recognized for many decades.74,231 Pain is defined as a sensory and an affective experience, and reviews of pain assessment invariably emphasize that pain unpleasantness, or affective responses to pain, should be assessed along with pain intensity and other “sensory” features.65 Reviews of the biopsychosocial model of pain cite its substantial history, including Engel’s call for a new “medical model,”254 Fordyce’s seminal work on the contribution
of communication and contextual factors, and Loeser’s synthesis of biopsychosocial principles, and emphasize its nearly universal acceptance in principle if not practice. A good deal of empirical evidence underpins the biopsychosocial model, and few would likely argue that psychological constructs and processes are irrelevant to the experience of pain. In practice, however, psychosocial factors are often assigned secondary status and viewed largely as reactions to pain. As we will describe in the Distress section, longitudinal, observational research supports a strong bidirectional link between mood disorders and persistent pain; the development of an enduring pain condition confers a substantially increased risk for the subsequent diagnosis of an affective disorder, and psychosocial variables such as depression, anxiety, and distress are among the most potent and robust predictors of the transition from acute to chronic pain.

Across numerous studies, individuals with a variety of chronically painful conditions generally have a several-fold increase in the risk of experiencing clinically significant mood or anxiety symptoms, and instruments used to assess depression, anxiety, and distress have been recommended for use as outcome measures in randomized controlled trials of pain treatments. Because of the synergy between pain and negative affect, this makes good logical sense: efficacious analgesic treatments that reduce the frequency and intensity of pain should have a beneficial effect on patients’ affective states and appropriate treatment of emotional distress should have a positive influence on the experience of pain. Indeed, several randomized controlled trials in primary care settings have shown that antidepressant treatment in patients with comorbid chronic pain and mood disorders produces fairly rapid analgesic benefits that are anticipated by, and robustly correlated with, improvements in indices of psychosocial distress.

We should note that it is important not to confuse psychological constructs and processes with psychiatric illness. Although psychiatric conditions certainly co-occur with chronic pain, and chronic pain samples do show elevations in rates of psychiatric disorders, elevated levels of negative affect and diminished cognition at subthreshold levels for a psychiatric disorder also play an influential role in shaping pain responses and pain-related outcomes. For example, evidence suggests that elevations in negative affect and pain-specific distress are associated with reduced benefit from a variety of potentially pain-reducing treatments. Wasan and colleagues reported that back pain patients with high levels of negative affect experienced approximately a 50% reduction in oral opioid analgesia relative to patients with low negative affect. Recently, a number of relevant prospective studies have involved studies of interpatient variability in pain outcomes after surgery. Longitudinal studies evaluating variability in pain-related outcomes after joint replacement surgery highlight the importance of assessing mental health, or psychosocial functioning, preoperatively, because patients with higher baseline levels of anxiety and depression report less benefit, more complications, increased pain and analgesic use, and poorer function for years after total knee or total hip replacement.

Overall, recent reviews and meta-analyses support the importance of a broad array of psychosocial factors in shaping pain-related experiences and outcomes across numerous pain conditions. A good deal of this work has involved studies of back pain. For example, Taylor and colleagues noted that variables such as job dissatisfaction, low job control, minimal social support, depression, and interpersonal conflict were strongly associated with incident low back pain (LBP). In another systematic review and meta-analysis, similar processes such as distress, low self-efficacy, and pain-related fear were identified as crucially important in back and in neck pain. Reviews of other conditions such as postsurgical pain, chronic pelvic pain, fibromyalgia (FM), and neuropathic pain have reached similar conclusions. Some of these factors are discussed in further detail in the General Psychosocial Factors and Pain-Specific Psychosocial Constructs sections; here we simply note that these variables appear to serve as robust risk factors that confer vulnerability for the development of persistent pain. We should also emphasize that characterizing domains of variables as “psychological” or “psychosocial” refers principally to the method of assessment rather than the presumed underlying pathophysiological mechanism that drives pain-related outcomes. That is, although they may be assessed via patient self-report of cognitive and emotional processes, constructs such as somatic awareness, anxiety, and pain-related catastrophizing likely reflect altered peripheral and central nervous system processing of sensory stimuli. For example, these “psychological” features of patients are often significantly correlated with measures of somatosensory amplification or central sensitization. Indeed, recent reviews of vulnerability and resilience factors in chronic pain emphasize the association of psychological processes with neurobiological pathways such as epigenetic processes, cellular priming, and alterations in brain networks concerned with reward, motivation, and learning, and descending modulatory control (Fig 1). Thus, neuropathic processes of sensitization at the peripheral, spinal cord, and/or brain levels are likely to be heightened by psychosocial factors, present concurrently, longitudinally, or antecedent in relation to the painful condition.

Despite its widespread support, there has also been some criticism of the limitations of the biopsychosocial model of pain. The model is rather vague about the specific pathways by which its elements interact and there are often no clear boundaries between categories of
processes and constructs. Moreover, many of the explanations invoked by the biopsychosocial model to account for interindividual variability in pain-related outcomes are so multifactorial they are unfalsifiable by empirical research. Additional criticisms include the observation that most “biopsychosocial” studies do not routinely measure variables within each of the 3 domains (biological, psychological, and social); indeed, it has been suggested that the biopsychosocial model may overweight psychosocial factors, especially in the absence of clear anatomic pathology, which risks reverting to a dualistic perspective of mind versus body. Other researchers have noted that the biopsychosocial model, as commonly described, may be too restrictive because it fails to capture important elements of quality of life, such as spirituality and religion, which has led to the development of a biopsychosocial-spiritual model of chronic pain that was recently applied to patients with sickle cell disease. Still other approaches have emphasized behavioral aspects of pain, with a biopsychomotor model highlighting the critical roles of communicative pain behaviors, protective pain behaviors, and social response behaviors. Despite these criticisms, however, the biopsychosocial model of pain has been enormously valuable in shaping our understanding of individual differences in pain, and in guiding the development of efficacious and effective psychosocial and behavioral interventions to reduce the suffering and sequelae associated with persistent pain. The AAPT taxonomy is designed to give balance to the sets of biological, psychological, and social variables and importantly their interactions across chronic pain disorders. Each of these constituent domains should be considered in classifying all chronic pain disorders, hence the multidimensional system outlined.

**Mechanism-Based Pain “Models”**

Under the broad umbrella of the biopsychosocial approach to understanding chronic pain, a number of more specific, mechanism-oriented models have been developed to describe the pathways by which particular processes can influence pain-related outcomes. Perhaps the most widely known and influential of these models is the Fear Avoidance Model (FAM), which was advanced nearly 20 years ago to explain the development and persistence of disabling LBP in a subgroup of patients. The model proposes that pain-related disability is caused by an interacting, cyclical sequence of fear-related cognitive, affective, and behavioral processes (Fig 2). The basic concept underpinning the model is that fear of pain leads to a cascade of deleterious consequences. ‘Confrontation’ and ‘avoidance’ are postulated as the 2 categories of behavioral responses to fear about pain; the former leads to the eventual reduction of fear over time. Avoidance, in contrast, leads to the maintenance or amplification of fear, which in turn results in disuse and disability. Since its introduction, the FAM has inspired productive research and has grown to be the leading paradigm for understanding disability associated with a wide range of musculoskeletal pain conditions. Over the past decade, the original FAM has been extended to include learning, motivation, and self-regulation theory. In several recent systematic reviews of the elements of the FAM, including thousands of patients in clinical studies, the authors concluded that within cohorts of patients with LBP for less than 6 months, there was high-quality prospective evidence that fear avoidance behaviors were associated with more pain and functional disability, poorer treatment outcomes overall, and reduced probabilities of return to work, and decreased fear avoidance was associated
with improved clinical outcomes. Collectively, over three-quarters of published studies reported that baseline levels of fear avoidance significantly influenced treatment outcomes, with participants high in fear avoidance reporting more pain and disability, and showing lower levels of return to work after treatment. In addition, treatment-related reductions in fear avoidance beliefs were important mediators of treatment benefits such as reduced pain and return to work.

A key prediction of the original FAM is the specific, prospective, sequential inter-relationships between catastrophizing, fear, depression, and pain-related disability, and the role of fear as a common barrier to recovery. Many of the initial studies used cross-sectional analyses to test aspects of the FAM; these provided firm evidence of associations between the constructs of interest (eg, pain-related fear was positively associated with measures of disability), but longitudinal designs are needed to confirm the sequence and direction of relationships proposed in Fig 2. Interestingly, several recent studies using a 3-panel, prospective design (in which earlier changes in 1 variable, from time 1 to time 2, are investigated as predictors of later changes in an outcome variable, from time 2 to time 3) have failed to show that changes in pain catastrophizing precede changes in pain-related fear or that changes in fear precede changes in depression. These findings highlight a common conceptual problem in research that purports to examine causal psychosocial mechanisms: the hypothesized associations between variables of interest are often strong, but the postulated temporal pathways (variable X affects variable Y, which in turn affects outcome Z) are rarely specific. That is, although these factors inter-relate across time, there is minimal evidence that the sequence of influence unfolds uniquely in the manner specified by the model. Thus, although the extant literature provides valuable information on psychosocial constructs and processes that are related to the experience of pain, and in some cases supports the concept of specific variables as prospective risk factors, or protective factors, there is a general lack of definitive evidence for causal mechanistic influences.

The FAM emphasizes cyclical relationships between its hypothesized risk factors (catastrophizing, fear, depression), however, recent findings support the central importance of cumulative interactions among overlapping factors, with cumulative risk load being a key contributor to pain outcomes, and potentially serving as the optimal target of treatment. For example, patients with elevated scores on a greater number of risk factors (ie, those with a higher cumulative risk load) are more likely to develop prolonged pain and disability. The clinical value of this approach has been highlighted by findings that a single measure of cumulative risk load shows greater predictive strength and scope than combined severity measures of catastrophizing, fear, and depression. Additionally, stratifying clinical interventions on the basis of cumulative prognostic risk has been shown to lead to improved outcome and reduced treatment cost. Although the cyclical relationships of the FAM offer appealingly specific clinical implications (eg, treating catastrophizing before fear), model-relevant interventions fail to meet this level of specificity and increasing evidence suggests that cumulative, global risk indices may be a more important target of treatment than particular psychosocial constructs. Because of the complexity of chronic pain, it should perhaps not

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**Figure 2.** The FAM of pain. From: Vlaeyen and Linton.
be surprising that the FAM fails to identify a universal pathway leading to pain-related disability. Moreover, the unique associations between FAM measures (such as fear of pain and catastrophizing) and outcomes such as longitudinal changes in pain intensity or return to work after a painful injury are generally modest, with these measures often explaining 10 to 15% of the variance in outcomes in the context of multidimensional predictive models. For example, a given patient may indeed experience intense fear during an acute pain episode, which leads to later avoidance behavior and disability, but another may have a preexisting mood disorder that subsequently amplifies negative pain-related cognitions such as fear and catastrophizing. Despite the limitations described, this mechanism-based model has collectively produced enormous heuristic value in facilitating our understanding and testing of some of the pathways by which psychosocial processes can shape long-term pain-related outcomes.

A number of other explanatory biopsychosocial models have been proposed, and it would require more space than we have available to adequately describe them. We briefly mention one other model—the avoidance-endurance model (AEM)—which has some overlap with the FAM, although it emphasizes the importance of particular behaviorally-defined subgroups. The AEM hypothesizes that while some patients experiencing persistent pain will become fearful and activity-avoidant, others will show an "endurance response," characterized by maintained activity and task persistence. The type of endurance response is determined by affective and cognitive factors, because patients with high levels of anxiety and thought suppression will show a maladaptive "distress endurance response pattern" and others with high levels of positive affect and a tendency to minimize the threat value of pain will show a more adaptive "eustress endurance response pattern." Thus, the AEM highlights the interplay of psychosocial processes with behavior, and defines patient subgroups on that basis (ie, the adaptiveness of showing "endurance" in the face of pain depends on the psychosocial correlates of that behavior). Overall, these various models postulate that patterns of affect, cognition, and behavior interact with an array of neurobiological pathways to shape long-term pain outcomes such as disability. For examples of other disease-related biopsychosocial models, the reader is referred to publications on multiple sclerosis pain, sickle cell pain, cancer pain, and HIV-related neuropathic pain. A comprehensive assessment of the overlap and the unique features of these models would be well beyond the scope of the present article, but we note that many influential psychosocial factors are common to most of these disease-related models.

Evaluating Psychosocial Contributions to Chronic Pain Outcomes

In this section we discuss 2 broad categories of "mechanistic" studies. In the first, psychosocial processes either exist within an individual as preexisting "vulnerability" factors (eg, childhood trauma) or
potentially “protective” factors (eg, social support, or emerge in response to the experience of pain (eg, fear-avoidance behavior, self-efficacy). These psychosocial forces then shape individual variability in pain-related outcomes over time. For example, specific psychosocial characteristics place individuals at elevated or reduced risk for the transition from an acute to a persistent pain state, or for the development of pain-related disability in the context of a persisting pain condition. In the second type of mechanistic study, which involves an intervention within a group of patients with chronic pain, the treatment is hypothesized to directly affect a psychological factor, a change that is then associated with a subsequent change in one or more outcome variables of interest. That is, the psychological factor acts as a mediator (though not necessarily a causal mechanism) through which a treatment confers its benefits. This type of study parallels, in its structure, many biological and pharmacological studies in which a medication acts on a specific receptor, a transcutaneous electrical nerve stimulation (TENS) unit reduces the transmission of pain-related information in the distribution of a nerve, or a physical therapy regimen strengthens a particular group of muscles. In general, if a psychosocial process contributes causally to treatment-related changes in outcomes, then several conditions should be met. First, a change in the psychosocial factor should precede any changes in the outcome. Second, changes in that factor should be statistically related to subsequent changes in the outcome. Third, the temporal relationship should not be reversible; that is, changes in the outcome should not produce subsequent changes in the psychosocial factor (although meeting this criterion is complicated by the dynamic, bidirectional interactions between pain and psychosocial processes). A study meeting these conditions would provide substantive, although not definitive, evidence that the identified psychosocial process is on a causal pathway linking a treatment with an outcome. However, rarely do studies in this area meet such rigorous standards.

Often, mediation analysis is used to test the hypothesized effects. Mediation analysis offers a method of testing theories regarding the causal links between a predictor and an outcome. Mediators, also known as intermediate variables, or indirect effects, are variables that are on a causal pathway between predictor and outcome, and “explain” the effect of the former on the latter. Mediation analysis, which is increasingly applied to study psychosocial contributions to the experience of pain, tests whether the influence of a predictor or treatment on an outcome occurs via change in a particular intermediate variable, the mediator. Mediation analysis can be applied to data from various types of study designs, from cross-sectional surveys to randomized controlled trials, although different study designs impose different limitations on the interpretation of mediational effects.

Unfortunately, mediation analysis has been most frequently applied to cross-sectional data, often resulting in inappropriate causal conclusions. Cross-sectional mediation analysis, which uses patterns of between-subject variation to substitute for within-subject temporal variation, cannot provide the basis for causal assertions. Longitudinal designs are an essential prerequisite for drawing any type of conclusions about causal associations between variables. In addition, although many mediational studies evaluate a single mediator of the association between predictor and outcome, it is much more likely, in the context of a complex condition such as chronic pain, that a number of mediators contribute to any observed relationships.

To assess mediation in pain studies, linear regression, bootstrapping approaches, or structural equation modeling (SEM) techniques are most often applied. Linear regression is relatively simple to use and widely familiar to researchers but makes strong assumptions about the data that are not always met (eg, the assumption of no measurement error). In an influential publication, Baron and Kenny laid out several requirements that must be met to form a mediation relationship. In short, the independent (predictor) variable must be significantly associated with the dependent (outcome) and the mediator variable in univariate regression analyses, and in a regression in which the mediator and the independent (predictor) variable are entered together, the mediator must remain significantly associated with the dependent (outcome) variable, and the previously significant path between the independent (predictor) and dependent (outcome) variable must be reduced in magnitude, or rendered nonsignificant. Increasingly, mediation studies have used bootstrapping, which is a general approach to statistical inference on the basis of random resampling from the observed data. In general, the traditional Baron and Kenny regression-based mediation analyses has fairly limited power; bootstrapping has been widely recommended because it improves power, even in relatively small samples, and obviates concerns over violating normality assumptions.

SEM can also be used to test mediation effects, and is being increasingly used by psychosocial pain researchers. SEM is a combination of regression analysis and factor analysis and, although many of the same assumptions are made about the data, it handles the inclusion of several mediating factors more readily, it can include latent (unobserved) factors, and it can account for measurement error. SEM also provides goodness-of-fit statistics that allow comparisons between tested models. This technique does, however, require substantially larger sample sizes than traditional regression analysis. It is important to emphasize that studies using mediation analysis (including those that use SEM), no matter how sophisticated their statistical approaches, are limited by their design, and that cross-sectional studies cannot provide evidence for causal, mechanistic relationships between variables.
Psychosocial Factors Influencing Pain-Related Outcomes

In the following sections we evaluate evidence for a number of psychosocial factors that have been studied as contributors to the development, long-term consequences, and sequelae of persistent pain, as well as treatment-related outcomes. In general, these variables do not appear to be condition-specific; most have been studied across multiple AAPT diagnostic categories with similar results. Conceptually, we organize these factors as “general” psychosocial constructs and processes, which are not unique to individuals experiencing pain, and “pain-specific” psychosocial factors, which are defined and measured with reference to individuals’ pain experience. This review is not exhaustive; rather we highlight some of the most influential and commonly-studied factors (Fig 3). Specific assessment instruments to measure psychosocial constructs are described in a complementary article in this supplement to The Journal of Pain.230 It is important to keep in mind that many of the constructs discussed in this article overlap to at least a moderate degree. For example, catastrophizing is often significantly associated with indices of depression, anxiety, and fear of pain, with correlation coefficients that are frequently in the range of .4 to .6, revealing a substantial degree of shared variance among these constructs.59,94,253,257

General Psychosocial Factors

Distress

Depression, anxiety, and general indices of emotional distress are probably the most commonly assessed psychological factors in patients with persistent pain, and as a cluster of negative emotions, thoughts, and behaviors are also termed “negative affect.” Recent systematic reviews indicate that chronic pain patients show elevations, relative to pain-free controls, in all of these indices of self-reported negative affect.28,95 Although psychological symptomatology is often interpreted as a consequence of chronic pain, prospective studies suggest that premorbid psychological dysfunction represents a risk factor for the future development of numerous chronic pain conditions.54,66,139 Moreover, similar psychosocial constructs and processes predict the likelihood of transition from acute to chronic musculoskeletal pain (ie, higher distress levels are prospectively related to an increased probability of transitioning to chronic pain).54,183 Overall, there is a wealth of evidence that symptoms of depression, anxiety, and emotional distress contribute strongly (more strongly than pain intensity, in many studies) to key long-term outcomes of persistent pain such as physical disability,16,81,97,196 work disability,16,107,209 health care costs,16,18,81,97,196 mortality,107,209 and suicide.16,97,98 In general, these studies establish the association of pain with the deleterious outcomes of interest, and then show that some or all of that association can be statistically accounted for by indices of depression, anxiety, or distress. For example, in a recent study of lumbar fusion for degenerative spondylolisthesis, patients were followed after surgery for 2 years to determine the predictors of functional outcomes.180 In multivariate analysis, high preoperative symptoms of depression remained the only significant predictor of failure to return to work after surgery, even in multivariate models with pre- and postoperative pain intensity included, fully mediating the prospective association between pain intensity and occupational disability. Patients in the upper half of the distribution of preoperative depression scores were approximately one-third less likely to return to work and, among those who did return, took nearly twice as long postoperatively to begin working again.180

Childhood Traumatic Experiences and Post-Traumatic Stress Disorder

Strong prospective links have been observed between early traumatic experiences and the subsequent development of chronic pain.2,25,106 We should note that many of these traumatic experiences are social and interpersonal in nature. Childhood physical, sexual, and psychological abuse are reported to be risk factors for the adult development of pain conditions such as FM, irritable bowel syndrome, chronic pelvic pain, and temporomandibular joint disorders.2,166 Many of these effects are substantial in magnitude; a recent meta-analysis reported that the presence of past trauma was associated with a two- to threefold increase in the subsequent development of chronic widespread pain in multivariate models across dozens of studies; reports of abuse in childhood conferred a 97% increase in risk (ie, odds ratio = 1.97) for having a painful somatic syndrome (eg, FM) in adulthood.2 To date, it is not clear whether the association between trauma and later chronic pain is a direct result of exposure to the trauma, is driven predominantly by individual affective, cognitive, and behavioral responses to the traumatic event (eg, intense fear, avoidance behavior), or is primarily a retrospective attempt at explaining clusters of diverse symptoms for which there may be no immediately apparent etiology.52

Not all individuals exposed to trauma go on to experience pain-related consequences, of course, but such exposures appear to substantially enhance those risks. A recent meta-analysis reported that individuals who reported exposure to psychological trauma were nearly 3 times more likely (than those with no trauma exposure) to have persistent pain, regardless of the type of trauma.2 Moreover, it is not only abuse that confers risk for the subsequent development of persistent pain. In a prospective, longitudinal study of over 7,500 children surveyed at age 7 and again at age 45, those with childhood reports of distressing events such as hospitalizations, familial financial crises, and the death of a parent showed an approximately doubled risk for the adult development of chronic widespread pain.106 These associations remained even after adjusting for potential confounding variables such as psychological distress and socioeconomic status. Not surprisingly, the links between trauma and pain may summate cumulatively across the lifespan. On the basis of retrospective reporting, several
studies have shown that military veterans with combat exposure and post-traumatic stress disorder (PTSD) symptomatology may be more likely to have experienced previous childhood or adulthood traumas as well.\textsuperscript{116,117} Thus, it is possible that the large association of adult-experienced trauma (eg, combat exposure) with deleterious pain-related outcomes may reflect the cumulative effect of multiple historical traumas as well.

Some categories of traumatic stress appear more likely to serve as pain-relevant risk factors than others. For example, one longitudinal study noted that although some childhood stressful medical events such as prolonged hospitalization were associated with chronic pain in adulthood, other events such as childhood surgery conferred no additional risk.\textsuperscript{106} Overall, combat exposure and PTSD in adulthood are reported to have the strongest statistical association with chronic pain.\textsuperscript{2,25} PTSD is a psychiatric condition that results from exposure to a traumatic event, and involves an array of negative cognitive and behavioral response to the trauma, including emotional hyperarousal, avoidance behavior, and re-experiencing of the traumatic event. PTSD has been identified as a risk factor for chronic pain,\textsuperscript{99,100} for the transition from acute to chronic pain,\textsuperscript{122} and for elevated severity of pain and disability in abuse victims.\textsuperscript{262,263} A number of studies have evaluated PTSD symptoms as a statistical mediator of the association between trauma and various pain-related outcomes. In a cross-sectional primary care survey study, patient recall of child abuse was linked with the report of pain and pain-related limitations in adulthood, and current levels of PTSD symptomatology fully mediated those associations.\textsuperscript{187} Similarly, in a sample of veterans, PTSD symptoms mediated the association between childhood maltreatment (physical and emotional abuse) and physical health outcomes, including the presence and intensity of persistent pain.\textsuperscript{130} Finally, although a 30-year prospective study failed to find that PTSD symptoms formally mediated the longitudinal relationship between childhood abuse and chronic pain in adulthood, there was an interactive, synergistic effect of these variables, with the presence of PTSD symptoms amplifying the predictive effect of childhood abuse on later-life pain outcomes.\textsuperscript{131} Collectively, there is strong evidence from a number of studies that abuse and trauma are linked with the subsequent development and effect of pain, with PTSD symptomatology in adulthood making a substantial contribution to those associations.

Social and Interpersonal Processes

Social forces shape a variety of health-related outcomes, and pain is no exception. As noted in a review of the factors affecting adjustment to chronic pain in individuals with disabilities, most studies have focused on either perceived global social support or solicitous social responses (eg, offering to take over tasks or encouragement to become less active).\textsuperscript{102} Of more than a dozen studies of perceived social support as a contributor to pain-related functioning, most reported that more perceived social support was associated with better outcomes in persons with conditions such as spinal cord injury, multiple sclerosis, and acquired amputation,\textsuperscript{102} whereas a higher degree of solicitousness in the social environment predicted increased pain-related disability.\textsuperscript{102} The social environment may be particularly important for persons with acquired amputation during the first few months after the amputation, because several studies reported that patients with positive general social support were less likely to develop persistent phantom limb pain after amputation.\textsuperscript{82} The immediate social environment in the form of parents (for children experiencing pain) and spouses (for married adult patients with pain) exerts a powerful influence on pain-related outcomes. In the case of children with persistent pain, parents’ cognitive and behavioral functioning and responses in reaction to children’s pain have also been shown to play an important determining role in children’s pain responses.\textsuperscript{177-179,193} In particular, parental pain catastrophizing is strongly related to the development of children’s persistent pain after major surgery,\textsuperscript{174} and is significantly related to the child’s disability.\textsuperscript{89} Parental attention to pain and solicitous behaviors that encourage children to avoid regular activities may provide specific pathways by which parental catastrophizing amplifies a child’s pain experience and behavior.\textsuperscript{43,89,235}

It is clear that the interactions between patients with chronic pain and their significant others can either facilitate or impair adjustment to chronic pain.\textsuperscript{30,36,135} Studies across painful conditions illustrate the important role of significant others. For example, among couples, high levels of spousal depressive symptoms predict worsening patient disability and disease activity in patients with rheumatoid arthritis over a 1-year period.\textsuperscript{129} In cancer pain, social support and interpersonal effectiveness seem to play an important role in shaping pain report and general health.\textsuperscript{175} Patients with partners showing avoidant attachment styles and anxious attachment styles are more likely to report increased pain and decreased well-being.\textsuperscript{76,185,186} Patients’ attachment styles are also important predictors of pain-related outcomes among children and adults; individuals with anxious or insecure attachment styles are at elevated risk for poorer mental and physical health,\textsuperscript{128} for reduced engagement in physical activity,\textsuperscript{9} and for less treatment-related improvement in affective outcomes among patients participating in a multidisciplinary treatment program.\textsuperscript{124} It is also important to understand the nature (eg, supportive, solicitous, adversarial) of other important social interactions, such as relationships at work; lack of social support at work and dissatisfaction with coworkers; and interactions with the disability compensation system, which are among the most potent predictors of work disability related to pain.\textsuperscript{90,162,163} For example, Li and colleagues\textsuperscript{138} studied workplace support among arthritis patients; those who reported low workplace support were much more likely to develop depressive symptoms and work-related disability 18 months later. Moreover, differing social and occupational structures across countries appear to contribute to
cross-national differences in rates of return to work and occupational disability in the context of painful work injury. Anema and colleagues\textsuperscript{113,114} compared sustainable return-to-work rates between 6 different countries and found that differences in job characteristics and social disability systems were more important than medical interventions, patient, and injury-related factors in explaining the large between-country differences in rates of return to work after painful occupational injuries. Of course, the social environment can also be harnessed for adaptive purposes. Keefe and colleagues\textsuperscript{113,114} have added spouse-assisted coping skills training to standard cognitive-behavioral therapy (CBT) and multidisciplinary pain management programs, hypothesizing that the supportive and reinforcing effects of a spouse will facilitate improved pain-related coping and enhance self-efficacy for managing pain-related symptoms. Such interventions generally involve dyadic sessions that teach couples communication skills and use mutual goal-setting to assist chronic pain patients in acquiring, maintaining, and effectively deploying pain-coping skills. In the most recent randomized controlled trial, in patients with LBP and their spouses,\textsuperscript{1} the spouse-assisted intervention produced larger decreases in fear of pain and catastrophizing than the standard multidisciplinary intervention. Other individual social and interpersonal relationships are also important influences on pain-related outcomes. In particular, the results from many studies of psychotherapy process and outcome confirm that 2 interpersonal factors: 1) stimulating patient expectations that treatment will help; and 2) establishing a sound therapeutic relationship between patient and therapist, are crucial foundations upon which successful interventions are built.\textsuperscript{156} A handful of studies suggest that an index of the therapeutic relationship (ie, the working alliance) statistically mediates the positive effects of rehabilitative treatments among people with musculoskeletal pain.\textsuperscript{32,79,84} Indeed, creating and sustaining an effective therapeutic alliance appears to be a necessary and sufficient condition for promoting the pain-improving effects of diverse interventions.\textsuperscript{24,35} It is also the case that psychosocial processes such as depression can negatively affect patient-provider relationships. For example, a recent study showed that depression was associated with patient–physician discordance in estimates of disease severity\textsuperscript{15} (ie, depressed patients estimated their disease severity as much worse, on average, than did their physicians). Such discordance is likely to be common, especially in light of the “invisible” nature of pain, and it can have deleterious effects on patient satisfaction and adherence to treatment regimens.\textsuperscript{88}

**Pain-Specific Psychosocial Constructs**

**Catastrophizing**

Catastrophizing is a pain-specific psychosocial construct comprised of negative cognitive and emotional processes such as helplessness, pessimism, rumination about pain-related symptoms, and magnification of pain reports.\textsuperscript{39} Although catastrophizing positively correlates with general measures of negative affect such as depressive symptoms and anxiety, it also shows a unique and specific influence on pain-related outcomes.\textsuperscript{39,120,184} Overall, a higher level of catastrophizing has been shown to be a risk factor for the development of long-term pain, and for negative sequelae of pain such as worsening physical disability, higher health care costs, and the amplification of pain sensitivity among patients with LBP and joint pain.\textsuperscript{37,61,63} Retrospective survey studies in patients with musculoskeletal pain have indicated that catastrophizing often emerges as one of the most important pretreatment variables predicting surgical outcomes,\textsuperscript{137,202} and a risk factor that impairs the effectiveness of pain-relieving interventions.\textsuperscript{32,109} Longitudinal studies show associations of catastrophizing with worsening pain and reduced treatment benefit among, for example, arthritis patients recovering from knee surgery.\textsuperscript{60,70,194,238} Multiple randomized controlled trials have shown that pain patients with high pretreatment catastrophizing scores report less benefit from topical analgesics,\textsuperscript{150} cortisone,\textsuperscript{149} oral analgesics,\textsuperscript{199} pain-relieving surgeries,\textsuperscript{238} and psychosocial treatments such as CBT.\textsuperscript{53,232}

A recent study of patients with persistent orofacial pain, randomized to 6 weeks of either standard care or CBT and followed for 12 months, confirmed the treatment-mediating effects of catastrophizing.\textsuperscript{140} Patients with high levels of pretreatment catastrophizing, and those whose catastrophizing scores did not change after treatment, were significantly more likely to be nonresponders at 1 year follow-up. Indeed, baseline levels of catastrophizing in the nonresponder group were >1 SD higher than baseline catastrophizing scores for the responder groups.\textsuperscript{140} It is interesting to note that catastrophizing may have its most influential mechanistic effects in the context of active, rather than placebo treatments. In a recent trial of TENS for postoperative pain,\textsuperscript{190} patients who underwent joint replacement surgery were randomized to receive TENS, placebo TENS, or standard care (no TENS) for 6 weeks. Those in the TENS group with high baseline catastrophizing scores showed less pain reduction and reduced functional outcomes (eg, lower range of motion) at 6 weeks. In contrast, there was no association of catastrophizing with pain-related outcomes in the other groups (ie, those receiving placebo or standard care treatment).

Furthermore, the benefits of many diverse analgesic therapies appear to be explained partly by their effects on cognitive–emotional processes such as catastrophizing. This is certainly true for CBT and similar psychosocial treatments. Longitudinal process analyses indicate that changes in catastrophizing and negative affect precede changes in clinical pain.\textsuperscript{33,141,215,222} that CBT can produce substantial reductions in catastrophizing even among patients whose chronic pain has persisted for decades,\textsuperscript{167,171} and CBT’s catastrophizing-reducing
effects may last for months or years. 233 Multiple studies that use cross-lagged panel analyses, or similar statistical approaches, have shown that substantial portions of the variability in end-of-treatment outcomes for CBT and multidisciplinary treatment can be accounted for by early-treatment changes in catastrophizing. 29,31,33 Interestingly, as recent reviews point out, 101,220 we know relatively little about the mechanisms underlying CBT and other nonpharmacologic pain treatment approaches, and it may be that disparate treatments operate in part via common mechanisms. For example, changes in catastrophizing statistically mediate the benefits of CBT 31,33,105,233 and multidisciplinary treatment programs, 52 as well as exercise- and activity-based physical therapy interventions that do not explicitly target catastrophizing. 133,208 Smeets and colleagues 208 compared CBT, active physical treatment (ie, aerobic and strength training), and their combination, and found that the 3 active treatments did not differ significantly on pre- to post-treatment change in pain catastrophizing, but that pre- to post-treatment changes in pain catastrophizing predicted pre- to post- changes in most outcomes across the intervention groups (ie, catastrophizing diminished just as much in the active physical treatment group as in the CBT group, and reductions in catastrophizing were equivalently influential predictors of improvements in pain across groups). Across the active treatments, catastrophizing reduction accounted for 35 to 40% of the benefit of treatment in terms of reduced pain and disability. Collectively, these results suggest that reduction in catastrophizing among chronic pain patients may account for some of the beneficial effects of many behavioral pain treatments.

Catastrophizing clearly overlaps with numerous other psychosocial processes, showing positive associations with indices of depression, anxiety, distress, and fear of pain, and inverse associations with self-efficacy, optimism, and other positive factors. 59,94,169 However, even when controlling for some of these related factors, catastrophizing often retains a significant unique, predictive influence (although it is true that no published studies, to our knowledge, control for every other variable listed here). For example, after statistically adjusting for indices of depression and anxiety, catastrophizing remained significantly associated with such diverse outcomes as return to work, 77,216 pain-related physical disability, 216 risk for prescription opioid misuse, 154,155 brain responses to a noxious stimulus, 78,143 pain intensity, 9 pain tolerance, 225 and suicidal ideation. 62 Moreover, catastrophizing likely interacts with other processes such as social support. 28 It is not just the patient’s degree of catastrophizing that has been shown to influence important pain-related outcomes; spousal levels of catastrophizing and patient catastrophizing are modestly correlated with each other and often both emerge as unique influential predictors. 134,181 Similar findings were obtained when evaluating the influence of parental catastrophizing on children’s reports of pain, particularly postoperative pain. 174,176,189

Self-Efficacy

Self-efficacy is a broad concept that refers to an individual’s belief in his or her own ability to perform a certain behavior to achieve a desired outcome. 115,213 According to Bandura’s social cognitive theory, self-efficacy is a major determinant of individuals’ thoughts, feelings, and behaviors in stressful situations, and affects individuals’ ability to cope successfully when confronted with difficult challenges. Pain-related self-efficacy is often measured using self-report scales such as the general chronic pain self-efficacy questionnaire, 23 or disease-specific measures such as the arthritis self-efficacy scale (for patients with arthritis pain), 146 which assess patients’ perceived ability to control pain symptoms and to function despite pain (see Turk et al 230 in this supplement to The Journal of Pain). Self-efficacy has been characterized as a protective psychological resource in patients with persistent pain, 214 and a resiliency factor associated with improved functional outcomes among children, adolescents, and adults with chronic pain. 213 A number of prospective studies have assessed self-efficacy as an influential contributor to functional outcomes in a variety of painful conditions. For example, a longitudinal study in patients with chronic LBP showed that self-efficacy partially mediated the association between pain and disability at multiple study time points. 46 Moreover, changes in self-efficacy (but not changes in pain-related fear) over the 1-year course of the study partially mediated the association between changes in pain and changes in disability. 56 Very similar findings (eg, high self-efficacy is associated with better functional outcomes, and variability in self-efficacy mediates the association between pain intensity and disability) have been observed in other pain conditions such as arthritis, headache, 108 FM, 165 and pediatric pain conditions. 91 To illustrate, in a prospective treatment study, self-efficacy was among the most potent mediators of CBT-related improvements in pain and disability among patients with persistent orofacial pain. 32 Overall, high levels of self-efficacy are associated with lower reported intensity and unpleasantness of pain, and with less physical disability. As noted in recent reviews, 115,214 the persistent and pervasive nature of chronic pain requires patients to make constant adjustments to learn to live with their disease. Thus, many nonpharmacologic treatments target self-efficacy as an important process variable.

“Positive” Factors

Most of the frequently studied psychological facets of the biopsychosocial model could be broadly classified as having a negative valence (eg, negative affect, distress, trauma, catastrophizing). Indeed, some past reviewers of this literature have called for more attention to positive factors that may confer protection from and resilience against chronic pain and related suffering. 22,23,118,229 Such resiliency research focuses on how individuals successfully adapt to adverse stimuli or situations, such as prolonged and persistent pain, and its effect on multiple areas of physical, emotional, and social functioning. 39,108 Although resiliency factors
have been linked to outcomes in the FAM, previous research suggests that risk and resilience factors do not represent opposite ends of a spectrum because individuals can be concurrently high or low in both types of factors. \(^{254}\) This research suggests that consideration of risk as well as resiliency factors may help explain how individuals can live with chronic pain without concurrently experiencing disability. \(^{254}\)

A number of studies have indicated that improving active pain-coping is an important component of many nonpharmacological treatments. \(^{34,35,52,141,224}\) Such "active" coping generally includes engaging in positive thinking, making encouraging self-statements, distracting one's attention from pain, undertaking as much physical activity as possible within pacing guidelines, or using physical pain-reducing techniques such as relaxation exercises and stretching. For example, a recent prospective study of multidisciplinary treatment revealed that patients who entered treatment with stronger personal beliefs in their ability to control pain, and those who increased their use of positive self-statements and cognitive reinterpretation of pain, showed the most substantial decreases in pain-related interference at 6 months and 18 months after treatment. \(^{52}\) As the authors note, this highlights a process-oriented role for active cognitive coping mechanisms in shaping the outcomes of multidisciplinary treatment. That is, facilitation and encouragement of adaptive active pain-coping efforts may be one pathway by which such treatments exert their beneficial effects. It is important to mention, however, that negative cognitive–emotional processes were assessed in this study as well, and treatment-related changes in negative affective and cognitive states such as pain-related catastrophizing were stronger predictors of outcomes than "positive" factors.

With the fairly recent advent of interventions such as acceptance and commitment therapy and mindfulness meditation for chronic pain, a good deal of interest has arisen in what psychosocial processes may underlie the benefits of these and related treatments. \(^{119,120}\) Acceptance and commitment therapy is an empirically-based, process-focused psychological intervention that de-emphasizes active efforts to control pain, and encourages acceptance, psychological flexibility, and values-based action as the most productive response to persistent pain. \(^{158,159}\) Numerous cross-sectional studies have shown the important potential contributions of acceptance-related processes to the physical functioning of chronic pain patients. \(^{159,160,243-246}\) With higher levels of patient acceptance often buffering the effect of high pain severity on pain-related disability. Some interventional studies have also reported acceptance to act as a mediator in interventional research. For example, in a recent study of several hundred chronic pain patients completing multidisciplinary treatment, Akerblom and colleagues \(^{8}\) identified acceptance as the single most important mediator of treatment outcomes such as pain interference. Mindfulness has also been studied in a similar role: Schmidt et al \(^{120}\) compared mindfulness-based stress reduction (MBSR) with a pain education control condition, and reported that significant pre–post changes in mindfulness were equivalent across MBSR and placebo (ie, pain education), and that changes in mindfulness were strongly associated with a host of functional outcomes approximately equally across the 2 treatments. Other studies of acceptance-oriented interventions have arrived at similar conclusions regarding the importance of acceptance and psychological flexibility as process variables that may serve as treatment targets. \(^{159,243,246}\) Such findings suggest that, much like catastrophizing, shifts in "positive" psychosocial factors can be associated with, or potentially predictive of, individual differences in the outcomes of a variety of treatments, whether those treatments specifically target those factors (eg, MBSR) or not (eg, pain education). Indeed, some recent work has suggested that mindfulness-based interventions may have greater effects on pain-related catastrophizing, especially in the context of high levels of pain intensity, than traditional CBT approaches. \(^{49,55}\) Such findings suggest the possibility of tailoring individual psychosocial interventions on the basis of important patient characteristics, although we do not yet have firm evidence from large randomized, controlled trials on which to base such recommendations. For example, with the importance of the social environment in shaping pain responses, individuals with a supportive significant other might benefit most from couples-based coping skills training, which has been shown to outperform standard multidisciplinary treatments for some patients. \(^{1}\)

Finally, there has been some exciting recent work in the area of cognitive–behaviorally-oriented educational interventions that aim to increase knowledge of pain-related biology. \(^{147,168}\) Such Explaining Pain (EP) treatments include a range of educational techniques designed to change patients’ understanding of the biological processes that underlie pain; these changes in the conceptualization of pain are hypothesized to serve as a mechanism to reduce pain itself. EP interventions are grounded in educational psychology and current theories of pain biology. \(^{147,168}\) The core objective of the EP approach to treatment is to help patients shift from the understanding of pain as a marker of tissue damage or pathology, to the understanding that pain is a marker of the perceived need to protect body tissue. Recent reviews reported that EP interventions increase accurate knowledge of pain-related biology, decrease catastrophizing and pain-related negative affect, and reduce the intensity of patients’ pain. \(^{132,147,168,219}\)

Other Factors

Numerous other process variables have also been evaluated in mediational studies of treatment outcomes. Pain-related fear has already been discussed with respect to the FAM, and it is helpful to keep in mind that indices of fear and catastrophizing are strongly intercorrelated such that their unique influence can be difficult to identify statistically when they are measured together. \(^{27,256}\) Additional key process variables such as pain-related expectations likely overlap with these factors as well. Expectations are a crucial component of placebo
responses, they can strongly influence the outcomes of active treatments, from surgery,71,264 to opioid analgesics,20 to acupuncture.260 A recent analysis of multiple large acupuncture trials reported that patient as well as provider expectations for treatment success were potent predictors of response,259,260 with better pretreatment expectations prospectively predicting improved patient outcomes after treatment. Finally, measures of somatization, somatic focus, or somatic awareness assess important psychosocial characteristics as well, particularly in the setting of chronic widespread pain conditions such as FM or its comorbid conditions.54,66,67 These measures have rarely been studied as targets of change in interventional studies, but a good deal of evidence exists for their role as key risk factors predicting the development and course (including the transition from acute to chronic pain) of numerous pain conditions such as temporomandibular joint disorders,66 and neuropathic pain conditions like postherpetic neuralgia57,110 or burning mouth syndrome.198

“Downstream” Pathways

Psychosocial processes likely affect a number of specific pathways that convey some of their effects (whether beneficial or deleterious) on pain outcomes. In the following sections we touch on several such pathways.

Maladaptive Health Behaviors

General and pain-specific negative cognitions appear to reduce the likelihood of exercise and other health-promoting behaviors among patients with chronic pain, which may contribute to their effect on long-term pain outcomes such as functional disability. Features of pain-related catastrophizing have been shown to correlate with less effective medication use,172 less positive health behavior such as exercise,38 and a lower likelihood of attending scheduled treatment visits140,206; these are plausible pathways by which psychosocial distress could enhance disease, amplify pain, and promote mortality. In samples of obese patients with knee osteoarthritis, catastrophizing was associated with poorer weight management, with more frequent binge eating, with reduced physical capacity, and with reduced weight-related quality of life.210 In prospective studies in patients with acute LBP, those with high levels of negative affect and catastrophizing are most likely to engage in extended periods of bed rest, least likely to exercise, and most likely to become physically deconditioned over time.24,237 In contrast, protective and resilience factors such as social support are associated with greater engagement in physical activity and exercise.213

Information Processing Biases and Increased Attention to Pain

High levels of depression, distress, and catastrophizing, and low levels of self-efficacy for managing pain may produce attentional and information-processing biases that lead individuals to attend selectively and intensely to pain-related stimuli.48,188,201,234 Catastrophizers experience more difficulty controlling or suppressing pain-related thoughts than do noncatastrophizers, they ruminate more about their pain sensations, and their cognitive and physical task performance is more disrupted by anticipation of pain.188 Similarly, in samples of patients with painful rheumatic disease, individuals with clinical depression show a word-recall bias for disability-related and pain-related words,51 as well as a tendency to ruminate about pain-related word meaning.207 Collectively, the results of these studies suggest that patients with particular psychosocial characteristics conveying risk for negative long-term pain outcomes (ie, high levels of distress and catastrophizing, and low levels of self-efficacy) are most likely to anticipate pain, to interpret ambiguous signals as being related to pain, to attend to pain-related visual cues, and to experience interference of pain with other cognitive activities.

Central Nervous System Pathways

Progress in brain imaging has been exponential in recent years, producing evidence of alterations in brain structure as well as function among patients with chronic pain.50,68,148 Functional magnetic resonance imaging, positron emission tomography, and electroencephalography are commonly used to study the neural bases of pain. Other magnetic resonance-based measures (eg, diffusion tensor imaging, spectroscopy) are also being used to assess pain-related changes in the brain’s interconnections, chemistry, and structure to gain further insights into the neurobiology of chronic pain. Recent reviews nicely summarize the literature comparing patients with a variety of persistent pain conditions with pain-free controls,13,148,152 identifying a number of cortical regions that are considered to be important for the perception of pain.50,68 These include the primary and secondary somatosensory cortices, insular and anterior cingulate cortices, the prefrontal cortices, and many subcortical areas such as the periaqueductal gray, amygdala, and cerebellum. Many of these areas have been reported to have altered gray matter density in patients with persistent pain,145,170 and they also show changes in the brain’s default mode network and other resting state networks,145,170 suggesting long-lasting functional brain changes related to the presence of chronic pain. Non-neural components of the central nervous system also appear to be affected; patients with chronic back pain show enhanced microglial activation relative to pain-free controls.144 Although a thorough treatment of the role of cognition and emotion in shaping the brain’s processing of sensory information is well beyond the scope of this article, we note that many of the psychosocial factors mentioned previously have been shown to modulate the perception of pain and the neural consequences of chronic pain. For example, past studies of gray matter loss in FM have indicated that atrophy of specific brain regions is more strongly related to the presence of symptoms of anxiety and depression than to chronic pain.56 That is, psychosocial distress may directly contribute to
amplification of the central nervous system consequences of living with a long-term pain condition. Pain-specific cognitive and affective processes also have important associations with functional brain responses to pain. In several studies, higher levels of catastrophizing were related to enhanced functional magnetic resonance imaging responses to calibrated noxious stimuli in areas such as anterior insular cortex among FM patients 18 and also among pain-free adults. 203 Structurally, elevations in catastrophizing among patients with chronic abdominal pain were associated with thinning of the dorsolateral prefrontal cortex, a key pain-modulatory site. 21 Several psychophysical studies have also shown that catastrophizing, anxiety, and other negative affective processes are related to reduced effectiveness in descending pain-inhibitory systems. 236 In addition, we recently reported that impaired activity in regions of the prefrontal cortices mediated the association between catastrophizing and hyperalgesia in patients with FM. 142 This effect was observed even after statistically controlling for patients’ degree of depressive symptomatology, which is significantly positively correlated with catastrophizing scores. Finally, psychosocial and behavioral interventions that target cognitive processes have been shown to reverse these functional and structural brain changes over the course of just months. 204,205 Collectively, these findings substantiate the possibility that interventions which reduce catastrophizing and negative affect may produce long-lasting, adaptive shifts in brain processing of pain.

Conclusions

The AAPT provides an empirically-based, multidimensional, chronic pain classification system, within which psychosocial factors play key roles. As the tenets of the biopsychosocial model suggest, a number of these variables act as risk or resilience factors, influencing the probability of developing a chronic pain condition, the severity of pain-related consequences such as disability, and the success or failure of various pain treatments (Fig 3). Studies in patients with a variety of pain diagnoses reveal that “general” and “pain-specific” psychosocial variables exert substantive influences on pain outcomes. These psychosocial variables have anatomical and neurophysiological counterparts. That is, psychosocial processes do not exclude involvement of neurophysiological processes, but provide a useful, alternative perspective on these processes. At times, pain psychologists, pain psychologists, and philosophers have assumed that psychological concepts and processes used to explain pain would be gradually replaced by physiological concepts and processes. For example, in the 1970s and 1980s many philosophers would have predicted that the statement “my c-fibers are firing” would replace the statement, “I am in pain” as a description of an individual’s experience. 40-42 This has not occurred. In general, we doubt that the replacement of psychological terms with physiological terms will occur anytime soon, despite impressive advances in functional neuroimaging.

Future studies in this area may benefit from the measurement of larger sets of these process variables, and from additional theoretical work on their interrelationships, to further illuminate their interactions. At this point, additional cross-sectional mediational analyses are unlikely to make meaningful contributions to the nature of these biopsychosocial interactions, although longitudinal mediational studies may shed light on the temporal dynamics of such associations. An additional complication is that because some of the specifically-postulated causal and temporal associations (eg, the sequential cyclical relationships hypothesized in the FAM) have not withstood empirical scrutiny, there has been little consistency in how researchers organize the psychosocial variables being investigated. For example, in recent studies, depressive symptoms, catastrophizing, self-efficacy, and mindfulness have each been examined statistically as predictors, mediators, and outcome variables. This reflects the overlap among these constructs, but makes planning future process studies a challenge.

Such considerations are especially important in light of recent evidence that the theoretically-based techniques comprising particular treatment approaches may be less important than whether the techniques affect key factors that underlie changes in cognition, emotion, and behavior. 31,33-35 Treatment-related improvements in cognitive content variables such as pain catastrophizing, 104,212,221 self-efficacy, and perceived pain control 104,105,212,232 appear to be influential across modalities of intervention and across pain-related outcomes, although the hierarchical and temporal relationships among these factors are presently not well understood. Collectively, the complexity and profound variability in chronic pain highlights the need to better understand the interacting forces that determine the trajectory of chronic pain conditions, and we recommend that future studies using the AAPT classification system consider assessing the psychosocial factors identified in this article. It is important to acknowledge that psychological and social factors are not solely secondary reactions to persistent pain; rather, they are intricately involved in an amalgam of biopsychosocial processes that characterize chronic pain. Across biological diagnoses, a diverse array of psychological, social, and contextual factors need to be considered in their roles as potential risk factors, protective factors, and process variables within the dynamic system of forces that constitutes a chronic pain condition. Moreover, their broad applicability suggests that such factors should be considered in classifying patients within all domains of chronic pain disorders, regardless of presumed etiology (eg, neuropathic, musculoskeletal, inflammatory). The AAPT taxonomy represents an important, evidence-based step toward that goal.

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