

Pain Resilience: Issues of Modeling Dynamic Adaptation in Chronic Pain

Resiliencia ante el dolor: algunas cuestiones sobre favorecer la adaptación dinámica al dolor crónico

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In recent years, there has been increasing interest in processes and characteristics that may underlie resilient adaptation to chronic pain. With this recent increase in empirical inquiry, there has emerged a degree of ambiguity in terms between pain resilience and other constructs previously connected to effective pain adaptation, such as pain acceptance, psychological flexibility, and pain self-efficacy. Objectives of the current paper included reviewing recent clinical and empirical evidence in the area of chronic pain resilience and offering a synthesis of these findings, with a specific focus on issues of defining and operationalizing this construct, compared to other constructs relevant to pain adaptation. We conclude that resilience is best defined as a dynamic process related to both stable individual characteristics and contextual and state factors, such as goal contexts and affective states. Finally, the implications of this model are discussed in the context of the extant literature on psychological interventions for chronic pain.

Keywords: Psychological resilience, chronic pain, positive emotions, psychological flexibility

En los últimos años ha habido un creciente interés por los procesos y las características que subyacen a la adaptación resiliente al dolor crónico. El amplio número de investigaciones empíricas al respecto, ha puesto de manifiesto la ambigüedad en la definición de conceptos relacionados con la adaptación al dolor como la aceptación del dolor, la flexibilidad psicológica y la auto-eficacia relacionada con el dolor. El objetivo del presente trabajo es revisar la reciente evidencia empírica y clínica, en el área de la resiliencia frente al dolor crónico, ofreciendo una síntesis de los hallazgos, centrando el interés en definir y operacionalizar este constructo, comparado con otros constructos relevantes en la adaptación al dolor. Se concluye que la resiliencia es un proceso dinámico relacionado con características estables individuales y factores situacionales, como las metas o los estados afectivos. Por último, se discuten las implicaciones de este modelo en el contexto de la extensa literatura sobre la intervención psicológica en pacientes con dolor crónico.

Palabras clave: Resiliencia psicológica, dolor crónico, emociones positivas, flexibilidad psicológica

Pain resilience: Issues of modeling dynamic adaptation in chronic pain

Chronic pain is a leading global health concern, with over 30% of Europeans and over 40% of Americans reporting persisting pain (IASP, 2005). Chronic pain is a complex disease to study and treat. There is often only a weak correlation between physical or radiographic evidence of pathology and reported pain intensity (Finan, Buenaver, et al., 2013) and a long list of psychological, social and demographic factors have been found to play a significant role in experiences of and responses to pain (Loeser & Melzack, 1999; Price, 2000; Riley III, Robinson, Wise, Myers, & Fillingim, 1998; Riley et al., 2002). A large body of literature exists linking chronic pain to increased dysfunction; individuals experiencing recurrent or chronic pain experience greater levels of depression and anxiety (Bair, Robinson, Katon, & Kroenke, 2003; McWilliams, Cox, & Enns, 2003), report lower levels of physical functioning (Sturgeon, Darnall, Kao, & Mackey, 2015), tend to be less engaged with their social networks (Moore, Grime, Campbell, & Richardson, 2013; Sturgeon, Zautra, & Arewasikporn, 2014), and also show greater levels of disability (Winkelmann et al., 2011). There is, however, a subset of individuals with chronic pain who present with severe pain but exhibit high levels of physical and psychological functioning. These individuals have been said to demonstrate high “pain resilience,” a construct that is receiving growing recognition from researchers and clinicians as important in understanding and treating chronic pain.

As chronic pain is often not fully treatable, pain management becomes the primary clinical goal and integral to this approach is successful adaptation to living with pain, or pain resilience. Pain resilience has been conceptualized as a 3-dimensional model, comprised of sustainability, recovery, and growth (Sturgeon & Zautra, 2010, 2013). Sustainability is the extent to which a person maintains engagement in positive activities despite experiencing pain. Recovery is how quickly and successfully a person returns to baseline functioning, physiologically, emotionally and cognitively, after a pain flare-up. Growth refers to the development of new knowledge, skills, or strengths resulting from the experience of coping with pain. Resilient pain adaptation involves both resilience resources and mechanisms. Resilience resources are relatively static factors, such as personality characteristics like extroversion (L. J. Wright, Zautra, & Going, 2008) and optimism (Boselie, Vancleef, Smeets, & Peters, 2014). Resilience mechanisms are dynamic factors like cognitions, emotional states, and behaviors that promote more effective coping when faced with pain, such as social engagement (Zautra, Hamilton, & Yocum, 2000) and positive cognitive reappraisal (Garland, Gaylord, & Fredrickson, 2011). Trait measures of resilience have been linked to an array of positive outcomes in chronic pain including increased life satisfaction (Cohn, Fredrickson, Brown, Mikels, & Conway, 2009), increased physical function (Torma, Houck,

Wagnild, Messecar, & Jones, 2013), decreased disability (Elliott, Burton, & Hannaford, 2014), and greater emotional well-being and positive emotion (Cohn et al., 2009; Ong, Bergeman, Bisconti, & Wallace, 2006; Ong, Zautra, & Reid, 2010). However, there is significant ambiguity in the definition of resilience, which has implications for both measurement of resilience and interventions designed to enhance resilience.

Within the extant literature several studies have validated self-report measures that assess resilience as a trait-like construct, both in terms of overall or general adult resilience (Connor & Davidson, 2003; Friberg et al., 2006; Smith et al., 2008) and, more recently, scales that assess resilience to pain specifically. The recent efforts to assess pain resilience have taken the form of both validation of general adult resilience measures in chronic pain populations (Ruiz-Parraga, Lopez-Martinez, Esteve, Ramirez-Maestre, & Wagnild, 2015) and the development of scales containing items worded specifically to reflect various aspects of resilience to pain in healthy populations (Slepian, Ankawi, Himawan, & France, 2016), although no measure of resilience specifically to chronic pain yet exists. Unquestionably, an aspect of resilience is captured by each of these assessments, most notably the extent to which individuals are able to identify in themselves an innate ability to tolerate pain and, in some cases, to persist through or to recover from particularly painful or stressful experiences. Unsurprisingly, these scales have positively correlated with indicators of positive emotional health and have negatively correlated with measures of distress and dysfunction. However, we posit that this approach to defining and measuring resilience has some notable drawbacks.

Although resilience to pain is certainly related to key traits and stable factors, such as personality features, stable social networks and psychological traits, and aspects of one’s physical state that may be unchangeable (e.g., the intensity and intractability of chronic pain), this definition implies a degree of static adaptive responding across all painful situations, which may underestimate the complexities of situationally-based coping. For example, individuals who may effectively maintain their occupational pursuits despite pain may not show the same degree of adaptive coping in their interpersonal relationships. Further, treating pain resilience as a trait leads to a significant degree of ambiguity in definitions; if pain resilience is truly (and exclusively) a trait, how distinct is it from pain tolerance, acceptance of pain, psychological flexibility, pain-related self-efficacy, or, for that matter, simply the absence of more negative psychological processes commonly associated with pain, such as pain catastrophizing or perceptions of injustice related to one’s pain? The view of resilience as a trait may also be limited by some biases inherent in self-report, such as a tendency towards favorable self-presentation or the influence of situational or temporal factors, such as current pain or affective states; these factors may cloud our ability to rely strictly on the reporter to correctly assess his or her own level of resilience.

Perhaps most important, however, is that there is a general lack of attention paid to how resilience to pain may manifest across time, reflected in habituation and adaptive efforts that may enhance later responses to pain (Sturgeon & Zautra, 2016). Defining resilience exclusively or primarily as a trait may also be problematic because it is at least partially contradictory to the principles that support the use of psychological treatments for chronic pain; individuals entered into treatment for their chronic pain need not be “non-resilient” to benefit, nor is it particularly useful to rely on self-reported resilience to determine whether a patient is suitable for psychological intervention.

In the current manuscript, we will present evidence that resilience is best considered as a dynamic and contextually-sensitive process, rather than as a trait. We will illustrate this by examining some of the most key mechanisms related to chronic pain resilience and how they may relate but also be distinct from pain resilience. More specifically, we will discuss pain tolerance and goal context and review evidence that resilience must be examined in a temporal or longitudinal fashion, including evidence related to fatigue and the sustainability of behavioral efforts across time and long-term growth in chronic pain (manifested in terms of pain acceptance and psychological flexibility). Finally, we will discuss implications of the resilience literature for future research and treatment.

Methodology

The current review was intended as a critical synthesis of the extant literature on pain resilience, but was not conducted as a formal systematic review. Relevant studies were identified via searches conducted on Google Scholar and PubMed in June and July 2016, using the search criteria “pain resilience,” “psychological flexibility,” “pain acceptance,” “positive affect” or “positive emotion,” “sleep,” “fatigue,” “persistence,” and the search term “chronic pain.” Searches were not exhaustive, however, and priority of studies was determined informally by the lead author according to sample size, study procedures, and relevance to the topic of chronic pain resilience.

Pain tolerance and goal context

First, we present a rhetorical example to illustrate the potential complexity of defining resilience to pain. Assume that a healthy research participant enters an experimental study and is asked to submerge his or her arm in a tub of perpetually and severely cold water. Upon receiving these instructions, the participant submerges his or her arm into the cold water and leaves it submerged for an extended period of time, perhaps even long enough that the researchers intervene before permanent damage is done. Is this participant resilient? Certainly, we might assume that he or she has a very high pain tolerance. However, tolerance of pain is a necessary but not sufficient condition for pain resilience, particularly in increasing the likelihood of immediately sustaining functioning in the face of pain. Indeed, those patients who cannot tolerate pain would appear less likely

to continue to function effectively in cases where their pain may worsen. In this example, the participant follows instructions of the researcher and does “well” at the prescribed task; however, many researchers and clinicians might suggest that this task is essentially meaningless in itself, as it is lacking in ecological validity. Indeed, the participant’s willingness to persist despite the possibility of personal harm might even seem contrary to most definitions of resilience, as it is unlikely to promote long-term health and function. What is missing from this example that would allow us to evaluate pain resilience more effectively is a goal context; why would a participant subject himself or herself to such a painful condition?

Recently researchers have begun to emphasize the importance of motivation for pain tolerance and have identified goal orientation and pursuit of reward as key to pain resilience (Ceulemans, Karsdorp, & Vlaeyen, 2013a, 2013b; Coffey, Gallagher, Desmond, & Ryall, 2014; Karsdorp, Ranson, Nijst, & Vlaeyen, 2013; Karsdorp, Ranson, Schrooten, & Vlaeyen, 2012; Karsdorp & Vlaeyen, 2011). In experimental settings, researchers have found that cognitive interpretation (Fernandez & Turk, 1989; Jackson, Wang, & Fan, 2014), goal orientation (Ceulemans et al., 2013a; Karsdorp et al., 2013), and emotional states (Ceulemans et al., 2013a; Karsdorp et al., 2013; Karsdorp et al., 2012) can determine persistence in a painful task. The Motivation-Decision model of pain (Fields, 2007; Leknes & Tracey, 2008) proposes that there is an inherent and natural process of decision-making under painful conditions that will determine whether an organism will continue to persist despite the presence of pain. In short, when an anticipated reward or reinforcer is perceived as more important to survival than reducing pain, the organism will continue its pursuit. Notably, this model also appears to fit for negative emotional states under conditions of threat; as threatening cues may be interpreted as more important to survival than reducing pain, avoidant responses to pain may be superseded by adaptive responses that help the organism escape danger (Leknes & Tracey, 2008). This model has been supported by recent experimental studies in humans that have noted that manipulation of both approach-oriented goals (such as inspiring a sense of responsibility) and negative emotional states can increase persistence under painful conditions (Ceulemans et al., 2013a; Karsdorp et al., 2013).

In addition to experimental studies manipulating mood states and goals, there is also evidence that psychological factors related to positive expectancies and goal pursuit, such as optimism and hopefulness, can both promote increased behavioral persistence in healthy individuals (Solberg Nes, Carlson, Crofford, de Leeuw, & Segerstrom, 2011) and in individuals with chronic pain (Solberg Nes, Carlson, Crofford, de Leeuw, & Segerstrom, 2010). Individuals with higher levels of optimism demonstrate fewer behavioral, cognitive, and affective decrements in response to pain (Boselie et al., 2014; Bruce et al., 2014; Hanssen, Peters, Vlaeyen, Meevissen, &

Vancleef, 2013; Hood, Pulvers, Carrillo, Merchant, & Thomas, 2012; M. A. Wright et al., 2011). A similar, albeit smaller, body of literature has connected self-rated beliefs regarding one's purpose in life (i.e., understanding the purpose and direction of one's life and the extent to which individuals can identify and pursue goals that are consistent with their own values) to both enhanced habituation to experimental pain (Smith et al., 2009) and faster recovery after knee surgery (Smith & Zautra, 2004). These findings support the idea of relatively stable individual differences that promote persistence, even in the presence of pain. However, recent evidence also suggests that optimism may be malleable and thus may constitute a potential target for intervention in individuals with chronic pain (Littman-Ovadia & Nir, 2014; Meevissen, Peters, & Alberts, 2011). Taken together, the current evidence suggests that the context in which pain is experienced and the characteristics of the pain sufferer may interact in determining the adaptiveness of his or her response.

A key mechanism that may mediate the relationship between goal pursuit and adaptive responses to pain is positive emotion. Although a full review of the importance of positive emotion for individuals with chronic pain is beyond the scope of the current paper, other excellent reviews exist on this topic (Finan & Garland, 2015; Folkman, 2008; Hassett & Finan, 2016). It is important to note, however, that positive emotions are thought to play a key role in buffering against the negative consequences of pain and stress and also promote effective recovery after periods of elevated stress or pain (Boselie et al., 2014; DeWall et al., 2011; Finan, Quartana, & Smith, 2013; Fredrickson, 2001; Fredrickson & Joiner, 2002; Fredrickson & Levenson, 1998; Geschwind, Meulders, Peters, Vlaeyen, & Meulders, 2014; Karsdorp et al., 2013; Meulders, Meulders, & Vlaeyen, 2014; Pressman & Black, 2012; Yeung, Davis, Aiken, & Tennen, 2015). Further, one of the key antecedents to positive emotion is the pursuit of personally-valued goals (Coffey et al., 2014). The literature on pain acceptance, a key adaptive construct in chronic pain that will be detailed later, is also suggestive of this idea; individuals high in chronic pain tend to report a greater willingness to experience pain in service of pursuing their goals, which has been related to fewer negative emotions and greater levels of positive emotion (Kranz, Bollinger, & Nilges, 2010). Notably, however, the role of positive emotions appear to be complex; a recent review of resilience in chronic pain (Hassett & Finan, 2016) has emphasized that the implications of stable and time-varying levels of positive emotion for pain adaptation may be distinct. These authors assert that defining and enhancing resilience may thus be better understood as the malleability of positive emotions and other resilience traits and mechanisms. Consequently, future models may benefit from a greater degree of sophistication in both the measurement of related adaptive constructs (e.g., stability and variability of positive affect, fatigue, or activity levels across time) and how these factors are represented in statistical models.

Fatigue, avoidance, and sustainability of efforts across time

An additional implication of the Motivation-Decision model concerns the contingencies of reward and punishment surrounding pain. From an operant conditioning standpoint, the experience of new or more intense pain may act as a punishment, such that activities that elicit greater pain will decline in frequency with time as the organism (or pain sufferer) seeks to avoid future pain. Although this process is typically adaptive from the standpoint of acute pain (e.g., using an injured limb or touching a hot stove), prolonged avoidance in chronic pain may contribute to greater physical deconditioning (Asmundson, Norton, & Norton, 1999) and may increase vulnerability to future physical and psychological dysfunction (Vlaeyen & Linton, 2000, 2012). This phenomenon is complicated by the fact that relief from pain itself seems to function as a reinforcer, such that the discontinuation of painful activities corresponds to activation of neural regions related to reward processing, such as the nucleus accumbens (Leknes, Brooks, Wiech, & Tracey, 2008; Leknes, Lee, Berna, Andersson, & Tracey, 2011). These results seem to suggest that behavioral persistence under painful conditions, particularly across time, requires that the value of the expected outcome of one's efforts exceed the reward that the sufferer would experience simply by discontinuing the painful activity. However, this model does not necessarily describe how these efforts may be affected through prolonged effort.

Some empirical models posit that such adaptive efforts may require use of a greater number of "self-regulatory" resources, which are finite in number (Solberg Nes et al., 2010). After continued self-regulatory effort, and without proper time or capacity to recover, prolonged depletion of these self-regulatory resources may manifest in fatigue states, which are common in chronic pain and are routinely identified as key barriers against greater physical function and quality of life (Burke, Elliott, & Fleissner, 1999; Feuerstein, Carter, & Papiak, 1987; Kop et al., 2005; Murphy, Smith, Clauw, & Alexander, 2008; Pollard, Choy, Gonzalez, Khoshaba, & Scott, 2006; Sturgeon et al., 2015). Although the etiology and maintenance of fatigue states in chronic pain appear to be multifactorial and are related to the intensity of pain, sleep disturbance, mood problems, and aberrant physiological and inflammatory processes (Davis et al., 2008; Roy-Byrne et al., 2002; Skapinakis, Lewis, & Mavreas, 2004; Sturgeon et al., 2015; Sturgeon, Yeung, & Zautra, 2014), this concept of depleted self-regulatory resources has also been supported by empirical studies. Individuals with some chronic pain conditions, such as fibromyalgia and temporomandibular joint disorder, report chronically high levels of fatigue (Solberg Nes et al., 2010), and prior studies have demonstrated that greater levels of self-reported fatigue accompany periods of prolonged self-regulatory effort (Hagger, Wood, Stiff, & Chatzisarantis, 2010; Segerstrom & Nes, 2007). Although studies of fatigue in chronic pain do not share any unifying models of etiology or maintenance, it does appear sufficient to state that fatigue

may be related not only to medical and psychiatric symptoms that may naturally co-occur with chronic pain, but also may correspond with the frequency and intensity of adaptive efforts surrounding pain.

The depletion of self-regulatory resources and consequent fatigue states poses a conundrum in the context of defining pain resilience. On one hand, individuals exerting greater self-regulatory effort may show fewer immediate pain-related decrements to their mood, activity levels, or social relationships (i.e., demonstrating a greater degree of sustainability in the context of resilient functioning), but these prolonged efforts may also predispose them to greater pain fatigue in the near future (thereby demonstrating a failure of recovery) (Sturgeon & Zautra, 2016). Notably, even the benefits of other protective psychological factors, such as optimism, may be compromised when individuals experience a severe depletion of self-regulatory resources (Solberg Nes et al., 2011). This process is also consistent with prior studies demonstrating that individuals with chronic pain who tend to “overexert” themselves without consideration of their physical state are prone to greater flares (McCracken & Samuel, 2007). A question then emerges: how can individuals with chronic pain maintain healthier efforts to improve conditioning and maintain meaningful function without significant flares in their pain or fatigue? Traditionally, attempts at addressing this process have been made via cognitive-behavioral strategies such as activity pacing, in which individuals with chronic pain are urged to adhere to activity plans designed to elicit a moderate degree of activity that are individualized in an effort to optimize physical activity levels without significant post-exertional flares. However, the clinical efficacy of activity pacing strategies has received, at best, equivocal support in the literature; some studies (Andrews, Strong, & Meredith, 2012; Karsdorp & Vlaeyen, 2009; Nielson, Jensen, Karsdorp, & Vlaeyen, 2013) have concluded that there is little or no evidence that these interventions are effective in chronic pain, while others (McCracken & Samuel, 2007) have suggested that introduction of pacing strategies without appropriate psychological intervention in other areas (such as increasing acceptance of pain) may inadvertently increase behavioral avoidance and sabotage future function.

Despite the apparent equivocality of the empirical support for pacing strategies, there is evidence that other factors identified as promotive of effective recovery, such as positive emotions and sleep quality, may be promising targets for future interventions concerning fatigue. A recent daily diary analysis suggested that greater levels of positive states such as enjoyment may buffer against fatigue later in the day for individuals with fibromyalgia (Yeung et al., 2014). Relatedly, physical activity levels may bolster against decrements in positive emotion on days of higher fatigue (Hegarty, Conner, Stebbings, & Treharne, 2015). Another key target for future studies is sleep quality. Given that there is already a robust body of evidence linking disrupted sleep to fatigue in chronic

pain populations (Clauw & Chrousos, 1998; Irwin et al., 2012; Nicassio, Moxham, Schuman, & Gevirtz, 2002; Sturgeon et al., 2015), this assertion is unsurprising. However, recent evidence also suggests that sleep quality and positive affective states are significantly linked (Finan, Quartana, & Smith, 2015), which may suggest that concurrently addressing sleep problems and increasing sources of positive emotion may have a synergistic effect in improving future fatigue states. However, the specific efficacy of bolstered physical activity levels, sleep, and positive emotions in treating fatigue requires additional validation in future clinical studies.

Pain acceptance and psychological flexibility

Another key contributor to chronic pain resilience is pain acceptance. Pain acceptance has been broadly defined as a process of acknowledging that one has chronic pain, reducing maladaptive and ineffective efforts to reduce or eliminate pain, and learning to live a fuller life despite the presence of pain (McCracken, 1998). Pain acceptance is a robust predictor of effective adaptation to chronic pain and has recently been identified as a key contributor to chronic pain resilience (Ramirez-Maestre & Esteve, 2014; Ramirez-Maestre, Esteve, & Lopez-Martinez, 2014); individuals who report greater levels of acceptance tend to report less distress, less pain-related interference, greater levels of life satisfaction and overall function compared to those who are less accepting of their pain (McCracken, 2010; Mun, Okun, & Karoly, 2014). Recently, researchers have suggested that acceptance of pain, which has also been defined according to sub-factors representing a willingness to experience pain and continued activity pursuit despite pain, may reflect a greater underlying degree of psychological flexibility (McCracken & Gutierrez-Martinez, 2011; McCracken & Velleman, 2010; Scott & McCracken, 2015). The psychological flexibility model posits that maintaining awareness and engagement in the present moment allows an individual to adjust his or her behavior in accordance with personally-held values (Hayes, Luoma, Bond, Masuda, & Lillis, 2006). In the context of chronic pain, where recurrent pain flares may increase emotional distress, narrow cognitive coping repertoires, and increase reliance on rigid and ineffective coping strategies, psychological flexibility is theorized to protect against these damaging patterns and promote more adaptive coping. Although individual differences unquestionably exist, psychological flexibility (and, by extension, pain acceptance) is a presumed mediator of so-called “third wave” psychotherapies for pain, including acceptance and commitment therapy (ACT) and mindfulness-based stress reduction (MBSR) (Day, Thorn, & Burns, 2012). Thus, it is assumed that indicators of psychological flexibility are in fact malleable through intervention.

It is also possible, however, that the importance and salience of pain acceptance may evolve with time; recently, there has been a call to begin to incorporate time into models

of pain resilience (Keefe & Wren, 2013; Smith, Epstein, Ortiz, Christopher, & Tooley, 2013). In addition to models that examine trajectories of pain and pain-related affective distress (Collins, Katz, Dervan, & Losina, 2014; Zhu, Galatzer-Levy, & Bonanno, 2014), there is evidence that pain acceptance itself may have different implications for individuals with varying durations of pain. Some evidence suggests that pain acceptance may have more protective effects against pain-related decrements in function and self-regulatory fatigue for individuals who have been experiencing chronic pain from fibromyalgia and temporomandibular joint disorder for longer durations (Eisenlohr-Moul, Burris, & Evans, 2013). Although this finding certainly requires replication in other populations, it is among the few that illustrate the potentially evolving nature of pain-related coping across time.

In most cases (as in acute pain), the experience of pain is brief and there is typically no expectation that pain will last indefinitely past the point of healing of an injury. Indeed, acute pain is an adaptive biological signal because it inspires a fear or avoidance response that mobilizes the organism to protect itself (Leknes & Bastian, 2014). However, in cases of chronic pain, the needs of the pain sufferer change, as prolonged avoidance is unlikely to promote better long-term health or function. This fact in and of itself is unsurprising and, indeed, is the theoretical foundation of most management approaches for chronic pain. It is worth noting, however, that there is likely to be significant psychological adjustment from the time an individual first experiences a new painful sensation through the development of this pain as a chronic problem. In the course of this adjustment process, periods of ineffective coping, dysregulated mood, and decrements in physical and psychosocial function may occur as the individual copes with a new recurrent stressor; it has even been suggested that the development of chronic pain may contribute to the establishment of a new homeostatic set point (Craig, 2003). With time and concerted coping efforts, however, more resilient coping responses to pain may develop. To some degree, this process may develop naturally; there is some evidence that older individuals demonstrate greater levels of resilience to similar levels of chronic health problems than younger individuals (Terrill et al., 2016). However, it is likely that individual differences in coping efforts will hasten or slow the process of developing resilient responses to pain; even losses and failures of coping have been identified as key learning experiences in the development of later resilience (Gattuso, 2003). We suggest here that the construct of growth within the context of pain resilience is one that has not yet received adequate attention, but that acceptance of pain appears to be the most promising index of this process at present.

Although its absence from the literature is understandable for several reasons, most notably that chronic pain can impose such profound negative consequences on the life of a pain sufferer that a discussion of its benefits can seem inappropriate, there are parallels in other domains of psychological adaptation

that suggest that personal growth in chronic pain may be a phenomenon that warrants further inquiry. For example, studies of post-traumatic growth (Barskova & Oesterreich, 2009; Kashdan & Kane, 2011) and benefit-finding after adversity (Affleck & Tennen, 1996; Bower, Moskowitz, & Epel, 2009) suggest that individuals who have faced a significant stressor (such as a traumatic event, loss, or health problem) may buffer against the negative consequences of the event by identifying its positive aspects. Benefit finding has demonstrated protective effects in both healthy samples and in individuals with chronic illnesses: these effects include reduced physiological arousal after the event (Bower et al., 2009), reduced pain and distress (Katz, Flasher, Cacciapaglia, & Nelson, 2001), reduced disability (Katz et al., 2001), and benefits to interpersonal relationships (Danoff-Burg & Revenson, 2005). This concept can be difficult to approach, both from a clinical and empirical standpoint; many people with chronic pain may resist the idea that their pain conditions can be anything less than an entirely negative influence in their lives, and disagreeing with this sentiment can run the risk of being highly invalidating to their experiences. Nevertheless, there is precedent to wonder whether the ability to identify ways in which chronic pain may have promoted personal growth or learning may be an indicator of more resilient attitudes to pain, particularly as benefit-finding interventions have shown efficacy in populations with other significant medical problems, including cancer (Antoni et al., 2001; Cruess et al., 2000; Stanton et al., 2002). There is also evidence that benefit finding, like many other resilience mechanisms, is also malleable; individuals enrolled in mindfulness-based interventions seem to develop a stronger tendency towards benefit-finding, which subsequently reduces stress levels (Garland et al., 2011). Similar increases have also been found in individuals with multiple sclerosis after cognitive-behavioral therapy interventions (Hart, Vella, & Mohr, 2008). However, there is currently a lack of research concerning the protective effects of benefit finding in chronic pain, as well as the malleability of this construct through intervention in this population. Consequently, we urge attention to this topic in future studies.

Psychological intervention and psychological resilience

In this paper, we have presented evidence suggesting that resilience, rather than being a static trait, is best conceptualized as a dynamic process that is determined by not only characteristics of the individual, but also psychological mechanisms known to increase tolerance of or resistance to the negative effects of pain, such as positive emotional states and goal context. We suggest that individuals who show greater resilience to pain are those who report more accepting attitudes toward their pain, maintain greater levels of behavioral effort and positive emotional states during times of pain and duress, and identify salient personal goals and adjust their coping efforts accordingly to pursue them. Importantly, resilience to pain appears to be comprised of

three overlapping and mutually-influential faces: sustainability, recovery, and growth. As we have noted in prior sections, sustainability may manifest as perhaps the most observable resilient response, but may not show appropriate maintenance across time if recovery processes are not adequate. Even more broadly, sustainability and recovery both may evolve with time, reflecting a degree of personal growth (as in the case of pain acceptance) that modifies the entire system of appraisal and coping for an individual with pain. As a result, these factors should not only bolster sustainability processes, but also protect against failures in recovery that can occur when unsustainable adaptive efforts are made (such as ignoring one's level of physical symptomatology when pursuing a particular goal). Currently, this definition does not imply whether an individual is able to self-identify resilience, nor whether this process would enhance coping efforts, though the extant literature on pain-related self-efficacy might suggest that the ability to identify oneself as resilient may yield psychological benefits (Anderson, Dowds, Pelletz, Edwards, & Peeters-Asdourian, 1995; Arnstein, Caudill, Mandel, Norris, & Beasley, 1999; Jensen, Turner, & Romano, 1991).

From the standpoint of psychological interventions, a few conclusions appear to be appropriate. Just as there is significant variability across people in both their attitudes towards pain and their pain coping repertoires, there are likely multiple ways to enhance resilience in individuals with chronic pain. For some individuals, it may be that they have enough inherent coping skills and psychological hardiness that they never require psychological intervention; for those who are able to maintain meaningful physical and psychological function and fulfilling social relationships in a sustainable way despite the presence of recurrent pain, no additional interventions may be needed. For others, it may be that they are psychologically prepared to adopt a management, rather than cure-focused, approach to their chronic pain, but lack appropriate coping skills to do so; for these individuals, an approach such as cognitive-behavioral therapy for pain may be indicated (Ehde, Dillworth, & Turner, 2014). In other cases, however, there may be stronger adverse psychological reactions to chronic pain that impair an individual's ability to immediately adopt a management approach to pain; this may be true of individuals reporting high levels of anger or perceptions of injustice related to their pain (Scott, Trost, Bernier, & Sullivan, 2013; Scott, Trost, Milioto, & Sullivan, 2015). In these cases, it may be that there are specific deficits in psychological flexibility (or, more directly, a high degree of psychological rigidity) that reinforces maladaptive responses to pain that cannot be addressed simply with psychoeducation and introduction of coping tools (Pincus & McCracken, 2013; Scott & McCracken, 2015; Scott, McCracken, & Trost, 2014). In these cases, interventions that bolster psychological flexibility, such as MBSR or ACT, may show a more robust effect (McCracken & Morley, 2014; McCracken & Vowles, 2014).

The topic of positive emotions warrants special mention here. To date, there has been a relatively sparse body of evidence suggesting that positive psychology-focused interventions, such as those designed to increase gratitude, forgiveness, savoring of positive events, and optimism, may be of use in chronic pain populations. We do not presume to state that these interventions cannot be useful in chronic pain; indeed, the broader evidence suggests that the amelioration of conflictual or otherwise unsatisfying social relations and enhancement of positive emotional states would serve to substantially improve resilient responding in chronic pain. However, preliminary trials of these interventions thus far have shown modest efficacy (Flink, Smeets, Bergbom, & Peters, 2015; Muller et al., 2016). It may be that these interventions have encountered the same difficulty that clinicians sometimes encounter, in that the goals of the intervention are mismatched to the goals of the patient. In prior adaptations of "stages of change" models of psychotherapy to the treatment of chronic pain (Kerns, Rosenberg, Jamison, Caudill, & Haythornthwaite, 1997), it is suggested that individuals may present for treatment at different times with different needs from their providers. For those who already demonstrate significant insight into the need for management approaches and a similarly high level of motivation, they may benefit from a more directive, psychoeducational approach designed to broaden coping repertoires. Similarly, those patients who do not show elevated degrees of maladaptive psychological processes related to pain (such as pain catastrophizing or perceived injustice) may be more likely to benefit from positive activity interventions (Hassett & Finan, 2016). Conversely, those patients who present for medical or psychological appointments with high levels of emotional distress, social conflict, and physical dysfunction may not be in an optimal psychological state to be receptive to suggestions of increasing positive emotions or adoption of a forgiving approach to past wrongs. If it is true that elevated psychosocial distress reduces receptivity to positive emotion-focused interventions, then the beginnings of a "stepped care" model of pain psychotherapy begins to emerge, in which therapies can be assigned flexibly according to these specific characteristics and needs of the patient. However, this suggestion is, at present, only a theoretical model and thus requires substantial validation in future clinical studies.

Conclusions

Resilience to chronic pain is a complex construct and is likely best defined as a dynamic process that is constantly evolving according to the interplay of personal characteristics of the person with pain and situational factors that may be salient at each moment. Both the identification of personally-relevant goals and concurrent underlying psychological mechanisms, such as positive emotional states, may significantly alter adaptive efforts under painful conditions, and more stable underlying traits, such as accepting attitudes towards pain and

psychological flexibility, may enhance the salience of these mechanisms. We suggest that resilience to chronic pain is thus a state that can be reached via multiple pathways of both normal adaptation to pain and clinical interventions designed to alter attitudes, coping responses, and cognitive and emotional reactions to pain. Those individuals who demonstrate the greatest degree of resilience to their pain are thus those who are able to effectively identify the ways of directing their coping efforts that yield the greatest benefit to themselves in both the short and long term.

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