

Understanding the Etiology of Chronic Pain From a Psychological Perspective

Citation for published version (APA):

Linton, S. J., Flink, I. K., & Vlaeyen, J. W. S. (2018). Understanding the Etiology of Chronic Pain From a Psychological Perspective. *Physical Therapy, 98*(5), 315-324. <https://doi.org/10.1093/ptj/pzy027>

Document status and date:

Published: 01/05/2018

DOI:

[10.1093/ptj/pzy027](https://doi.org/10.1093/ptj/pzy027)

Document Version:

Publisher's PDF, also known as Version of record

Document license:

Taverne

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

www.umlib.nl/taverne-license

Take down policy

If you believe that this document breaches copyright please contact us at:

repository@maastrichtuniversity.nl

providing details and we will investigate your claim.

Understanding the Etiology of Chronic Pain From a Psychological Perspective

Steven J. Linton, Ida K. Flink, Johan W.S. Vlaeyen

The etiology of chronic pain-related disability is not fully understood, particularly from a clinical perspective. Investigations to date have identified risk factors and elucidated some important processes driving the development of persistent pain problems. Yet this knowledge and its application are not always accessible to practicing physical therapists or other clinicians. This article aims to summarize the main psychological processes involved in the development of chronic pain disability and to derive some guidelines for treatment and future research. To this end, the focus is on the paradox of why coping strategies that are helpful in the short term continue to be used even when—ironically—they maintain the problem in the long term. To aid in summarizing current knowledge, 4 tenets that elucidate the etiology of chronic pain are described. These tenets emphasize that chronic pain disability is a developmental process over time, contextual factors set the stage for this development, underlying transdiagnostic psychological factors fuel this development, and the principles of learning steer the development of pain behaviors. With these tenets, an explanation of how a chronic problem develops for one person but not another is provided. Finally, hypotheses that can be empirically tested to guide clinical application as well as basic research are generated. In conclusion, understanding the psychological processes underlying the etiology of chronic pain provides testable ideas and a path forward for improving treatment interventions.

S.J. Linton, PhD, Center for Health and Medical Psychology, School of Law, Psychology, and Social Work, Örebro University, 701 82 Örebro, Sweden. Address all correspondence to Prof Linton at: steven.linton@oru.se.

I.K. Flink, PhD, Center for Health and Medical Psychology, School of Law, Psychology, and Social Work, Örebro University.

J.W.S. Vlaeyen, PhD, Health Psychology, Katholieke University of Leuven, Leuven, Belgium; and Department of Clinical Psychological Science, Maastricht University, Maastricht, the Netherlands.

[Linton SJ, Flink IK, Vlaeyen JWS. Understanding the etiology of chronic pain from a psychological perspective. *Phys Ther*. 2018;98:315–324.]

© 2018 American Physical Therapy Association

Accepted: February 12, 2018
Submitted: May 3, 2017



Post a comment for this article at:
<https://academic.oup.com/ptj>

Despite years of research aiming to solve the problem of “chronic” pain, understanding of its etiology, particularly from a clinical point of view, is only rudimentary. Although various forms of chronic pain and dysfunction affect a large proportion of the population^{1,2} causing unmeasurable distress and considerable costs,³⁻⁵ clinicians still struggle to understand why some patients develop pain-related disability while others do not. To be sure, considerable neurophysiological and psychological advances have been made,⁶⁻¹⁰ but there is nevertheless no comprehensive explanation for the etiology of chronic pain in the clinical setting. A striking feature is that although patients as well as practitioners may intuitively expect chronic pain disability to be caused by serious acute trauma (eg, lifting) or multiple “microtraumas,” the scientific literature shows that most people, at some point, have a pain problem, but only a few develop chronic disability.¹¹ Furthermore, most cases are not associated with a single trauma and less than 1% have “serious” pathology.¹² Thus, clinicians may often struggle to understand why some patients develop chronic disability while others do not and this situation, in turn, makes the provision of care a challenge.

Chronic pain represents an enticing paradox: it persists with no apparent benefit to the individual. Responses to pain that at 1 time point and context are helpful, appear to have the opposite effect at a later time and context. People experiencing acute pain use various strategies such as rest or medication to reduce pain intensity and enhance healing. Paradoxically, these same responses may contribute to the problem when they persist too long. Rest, as an illustration, is helpful for healing early on, but may lead to difficulties in maintaining meaningful activities in the longer perspective. Patients and researchers struggle with understanding why these responses continue when they appear to be of no help.

This article aims to provide an account of the journey from acute musculoskeletal pain (eg, back or neck pain) to a persistent pain-related disability from

a psychological perspective. Moreover, we aim to communicate this in a manner that is relevant for practicing physical therapists and other clinicians, such as doctors, nurses, or psychologists. Indeed, physical therapists are likely the main provider of care for people with musculoskeletal pain and how the physical therapist approaches and manages the case is of considerable importance. Our hope is that by underscoring psychological processes that substantially drive the development of a persistent problem, we can also highlight the “whys” and “hows” so that physical therapists and others can apply this knowledge in clinical practice. We make no claim that this is the only approach, but we do maintain that psychological factors are intimately involved. In fact, several current models are based on cognitive, behavioral and emotional mechanisms.^{8,13-16} We build on known psychological factors that drive the development of chronic pain and provide some tenets as heuristic aids. From these tenets we attempt to explain why 1 patient may develop chronic disability while another does not even though they have similar “injuries.” We also present testable hypotheses based on the tenets that guide clinical application and research.

Unraveling the Paradox of Chronic Pain

To unravel the paradox of chronic pain, it is necessary to understand why a behavior that is helpful at 1 point in time persists even when it seemingly begins to exacerbate the problem. A basic difference between those who become incapacitated and those who do not may be how the pain is dealt with rather than the quality or intensity of the pain itself underscoring the role of psychological processes.¹⁷⁻¹⁹ In order to concretely examine the etiology of chronic pain, we provide 2 illustrative short cases.

Case 1—Lydia

Lydia works as an administrator at a busy bank and is happily married with 2 children. She grew up in a close family where her father’s recurrent stomach problems were the center point for the

family’s worry. She did well in school and has advanced in her work to a managerial position.

About 4 years ago, Lydia sought care for a back pain problem for the first time. Because her employment involves considerable time at a computer station, she wondered if the pain was related to her work. The pain started gradually first appearing after a long day’s work the previous day, and it became problematic with many repeated bouts. After nearly a year of struggling she decided to seek care because she was concerned that she had a serious disease—why else would it continue like this? She was examined, received a local treatment, and started an exercise regime with her physical therapist who said the pain was related to her muscles. Although this relieved the pain somewhat at first, her worries continued and the effects were short-lived. She says that the pain is unpredictable, difficult to describe, and comes and goes. Sometimes excruciating pain makes it difficult to work and she has been on the sick list several times. Besides finding this frustrating, she has become irritable and blue. Over the years Lydia has tried taking painkillers, resting, exercising to increase muscle strength and mobility, stretching, an ergonomics course, a better chair, different sitting positions, yoga, and hot baths. Despite these interventions, the pain has become a continuous problem that is now significantly affecting Lydia’s sleep. Although the physical therapist and doctor had tried their best they did not see any alternative treatments. Finally, the doctor told Lydia that she likely had repetitive strain injury and provided a prescription and advised her not to resume full duty at work. Lydia now rests several times a day but takes short walks for exercise. However, Lydia says that she is very doubtful whether she will ever be able to work full time again.

Case 2—Caroline

Caroline works at a department store and lives with her husband and son. She has always been an active person and did well in school. Her parents have supported her development and

schooling, and she enjoys close contact with her family.

Caroline sought care for her back after an episode while organizing merchandise at the store. She felt a “jab” in her back that got better after a coffee break, but the next morning her back and shoulders ached. This concerned Caroline because she had never had pain quite like this. Although she expected the pain to disappear after a few days, it continued. Caroline finds her work stressful, as she mainly deals with customers’ reports. Caroline sought care wondering why the injury took so long to heal and whether her work exacerbated the problem. Caroline’s physical therapist told her that the pain was caused by a soft tissue injury and that this would heal, but more slowly than she anticipated. She was advised on using analgesics during the recovery period. Further, her physical therapist informed her that exercise was good for enhancing the healing and she was given a regime of exercise. Finally, she was told by her doctor and physical therapist that she could continue working, but that she should take pauses during a 2-week period as needed. Caroline was pleased with the information and gradually recovered. During the past year she has experienced a couple bouts of back pain, but she has been able to manage these without seeking health care.

In these scenarios, Lydia and Caroline have similar back pain problems, but they have different reactions and outcomes. Why does Lydia develop a chronic problem, whereas Caroline does not?

Explaining the Paradox: The Tenets

On the basis of the literature, we have developed 4 tenets to help explain the paradox of chronic pain and why Lydia develops it but Caroline does not.

Tenet 1: Chronic Pain Is a Developmental Process

Chronic pain does not simply occur, but rather it transpires over the course of relatively long periods of time. The defi-

nition of chronic pain simply encompasses a time period (3–6 months)^{20,21} but fails to consider other aspects. This implies that once the duration of a pain report reaches this limit you then “have” chronic pain. Various suggestions for improving the definition point out aspects such as severity and impact on function. Remarkably, the current evidence also reveals a more intricate course that warrants a developmental perspective.

Although the definition of chronic pain implies linear progression over time, the evidence shows that pain (eg, musculoskeletal) is cyclic in nature.²² Individuals usually have an episode of pain that gets better only to be followed by a recurrence that is followed by yet another recurrence.^{2,23} Chronic problems are characterized by having repeated bouts interspersed with relatively better periods rather than a single episode that becomes chronic after 3 months.¹² In fact, patients assessed at a first visit in primary care report having had recurrent problems over long periods.^{24,25} Even when we actively recruited participants from the workplace, they reported recurrent problems over several years,²⁵ a fact reported in other studies as well.^{24,26,27}

The recurrence of pain episodes over long periods of time has fundamental implications for understanding how chronic pain develops. First, pain triggers a number of negative emotions (eg, fear, frustration, anger) and thoughts (catastrophizing). From a motivational point of view, these emotions and cognitions drive overt behavior.²⁸ Because some emotions and thoughts are particularly aversive,²⁷ they may power attempts to avoid them.¹⁴ Second, the recurrent nature provides ample opportunities for learning to occur (tenet 4). Each episode of pain presents an opportunity for “controlling” it and the consequence of doing this guides future behavior. Recurrence may produce gradual changes in daily routines that are not even consciously observed by the patient.²⁹

The developmental tenet does not stop here as experiences prior to the

injury are also relevant. Psychological research shows that early life experiences generate response patterns that may become rigid.³⁰ For example, children who observe parents reacting non-fearfully to phobic stimuli like a snake are immunized.²⁹ Similarly, exposure to abuse increases the risk for chronic pain.^{31–34}

This tenet underscores that Lydia’s problem has developed over considerable time, with many unsuccessful attempts to treat it, and it has gradually become worse. The repeated bouts have resulted in a *pattern* of responses—such as worry and avoidance—that continues to drive this progression. By comparison, Caroline has experienced a single episode. Caroline experiences her pain as a logical result of a situation at work, whereas Lydia’s onset was insidious and the bouts are unpredictable. Because Lydia has experienced a childhood with a “sickly” role model (her father), it can be foreseen that she will become worried and fearful; these responses promote behaviors that are counterproductive in the long run. In contrast, because Caroline has experienced a sense of control while growing up, she will more likely employ effective ways of managing the pain and its treatment.

Tenet 2: Contextual Cues Set the Stage

Because the environment is continually changing, contextual cues provide an important opportunity for people’s behavior to be adjusted accordingly. The paradox of the development of chronic pain is linked to how well people’s response to the pain is in line with the context in which it occurs. Understandably, people respond to acute pain to alleviate it and enhance function in the short term.²⁸ As the pain problem progresses with recurrences, internal (feeling stiff) and external cues (how partner responds) provide signals that steer these attempts to reduce discomfort. To recover, it is essential to read accurately the appropriate cues and adjust responses to be in line with them.³⁵

We assert that most behavioral reactions to painful stimuli are natural, but

Etiology of Chronic Pain

that sometimes people continue with these responses even when the context changes thus contributing to the development of chronic pain.³⁶ Lydia, for example, continues to worry and tries to control the pain by, for example, resting and sitting, even though healing is being cued (passage of time, change in quality of pain). In other words, she fails to pick up on the cues that healing has occurred. Caroline, on the other hand, adapts her responses such as limiting strenuous calisthenics for a week and then gradually increasing them with signs of healing. So, although both Lydia and Caroline react adaptively to acute pain, they differ in how they respond to changes in the environment.

Although some contextual cues are quite salient, others (facial expression, body language) are not. Context (in) sensitivity is defined as how well an individual responds to the ever changing demands of the environment.³⁵⁻³⁷ While Lydia struggles to read internal cues (pain is “unpredictable”), responds inappropriately (eg, with rest), and does not appear to be receptive to the result, Caroline is sensitive to the context and develops her involvement in physical activities.

Context affects how clinicians view a patient's responses as well. Rather than viewing a particular strategy or response as always being adaptive or maladaptive, context provides important information that signals whether a given strategy will likely be helpful. Hence, avoidance may be appropriate in some situations (near a very hot stove) but inappropriate in others (receiving a required injection).³⁸ Finally, emotions influence context sensitivity because they demand people's attention and thereby makes people less attuned to other cues.³⁹⁻⁴³ For example, pain-related fear affects attention and, in turn, people's ability to detect subtle stimuli.^{44,45} Because Lydia responds to the pain with intense emotion (worry, depressed mood), this contributes to her insensitivity.

Tenet 3: Transdiagnostic Processes Serve as Drivers

This tenet describes how psychological mechanisms may serve to “drive” the

progression of co-occurring problems. Persistent pain conditions are almost always associated with a variety of comorbid symptoms including depression, sleep disturbances, and anxiety disorders.^{2,46-48} Typically, these co-occurring problems emerge together and become entwined with the pain problem. A transdiagnostic approach suggests that there are underlying psychological processes that account for the etiology of the pain and these co-occurring problems.^{46,49-51} These underlying processes, in other words, transgress diagnostic boundaries; and treating them should, therefore, result in improvements for the various symptoms. Thus, co-occurring depression and pain-related dysfunction might both be explained by certain underlying processes, such as catastrophizing⁵² and avoidance.⁴⁶ A transdiagnostic view then helps focus assessment and treatment on mechanisms shared by the co-occurring problems.

Table 1 illustrates core transdiagnostic processes relevant at different stages in the etiology of chronic pain disability.

Transdiagnostic processes such as avoidance and catastrophizing may drive the progression of co-occurring pain-related problems. Consequently, although Caroline has processes that reduce predisposing (eg, a stable childhood with a sense of control), and enhances protective processes (resilience, history of coping), Lydia does not. Instead, Lydia has greater vulnerability (childhood adversity and lack of control) but few protective factors. This helps to explain why Lydia is developing a long-term problem while Caroline is not, even though Caroline is exposed to roughly the same “trigger” process (eg, exposure to stressful work) as Lydia was. Lydia also gradually developed multiple problems in the form of sleep disturbances, activity dysfunction (eg, off work), and depression; in themselves, these problems may serve to catalyze the development of a chronic pain problem.

Tenet 4: The Fundamental Role of Learning

This tenet asserts that learning dynamically steers the development of people's

behavior over time and, therefore, is a key to unraveling the paradox of responses to pain that continue to drive its development. Because repeated experiences with the environment allow people to learn important relationships between events and situations, learning helps people predict the occurrence of certain events and the consequences of future behavior. Although behavioral responses to an immediate noxious stimulus are therefore natural,⁵³ a problem arises when these behaviors continue to persist beyond their usefulness. Three basic learning principles (schedules of reinforcement, generalization, and extinction) help with understanding this paradox and provide insights into interventions. However, before addressing these principles, we consider the role of pain in classical and operant learning.

Pain is a particularly potent stimulus in learning because of its aversive nature. The nervous system is designed so that pain is easy to detect as a stimulus and its noxious character is also a powerful motivator of behavior. Two types of learning steer people's behavior and, together, help us make constant adjustments to environmental events.⁵⁴ First, in classical conditioning, people learn to predict the occurrence of a potentially harmful stimulus such as pain. A neutral stimulus (sound of a bee; conditioned stimulus) is followed by an aversive stimulus (painful sting; unconditioned stimulus) resulting in muscle contractions and fear (unconditioned response). Because the buzz of the bee (conditioned stimulus) is now a reliable predictor of the sting (unconditioned response), the buzzing sound by itself can elicit fear and reflexive muscle contractions (unconditioned response). This association is stored in memory for future use and cannot be simply erased. Interestingly, just thinking about the buzzing sound can now activate the memory of the sting and thereby generate fear.^{55,56}

Second, in operant conditioning, people learn about the association between a behavior and its consequences in a given situation.⁵⁴ They learn that in a given situation (at home with a partner), a certain behavior (pain behavior, such

Table 1.Overview of Various Types of Psychological Processes That May Operate in the Development of Chronic Pain⁴⁶

Predisposing Processes	Triggering Processes	Protective Processes	Catalytic Processes	Driving Processes
Temperament (eg, trait anxiety, negative affectivity)	Exposure to acute aversive events	Positive affect	Off work	Worry and general anxiety
Childhood exposure to adverse, unpredictable environments	Acute stress	Optimism	Interpersonal distress	Avoidance
Intolerance of uncertainty	Emotional trauma	Resilience	Work stress	Catastrophizing
Helplessness (ie, no sense of control over environment during childhood)	Physical trauma	Coping strategies to solve problems	Poor sleep	Inflexible problem solving

as grimacing when lifting a heavy object) will likely have a certain result (the partner lifts instead). When people have pain, they emit typical behaviors, termed “pain behaviors,” that signal to others that they are experiencing pain and that may themselves reduce pain. Favorable outcomes increase their frequency,^{57,58} and verbal reports of pain intensity are steered by their consequences.^{59–61} This type of learning is important in the development of chronic pain, because people with pain develop new behavioral routines (eg, resting, walking, watching movies) that may be reinforced by the workplace, significant others, and the entertainment they provide.²⁹

Schedules of Reinforcement: A Key to Persisting Behaviors

One process that may explain the paradox is that once a behavior is firmly learned, it may be maintained with surprisingly little reinforcement. This relates to the schedule of reinforcement, that is, when and how often the behavior is reinforced. By gradually “thinning” the schedule various behaviors may persist even though they no longer are helpful. When learning a new response, people often receive reinforcement for every response, so that the association between the behavior and the consequence is clear. In most other situations, however, reinforcement is not continuous and is instead provided intermittently. How and when a behavior will be followed by reinforcement influences its resilience to extinction: once a response has been established, gradual reductions in the frequency of reinforcement result in resistance

to extinction.^{54,62} Although this may seem counterintuitive, the less frequent reinforcement reduces the ability to predict the reinforcement, and people continue to respond because they are not “sure” when the behavior will result in reinforcement.

Schedules may help to explain inflexible persistence of certain pain behaviors.^{8,16} Pain is a powerful stimulus that is characterized by flare-ups and recurrent bouts and can consequently be quite unpredictable.⁶³ Lydia has attempted to control her pain by doing several things like resting, sitting in a certain way, or doing yoga. Because of the variability in the pain, these may occasionally be followed by reductions. Thus, Lydia is on a variable schedule that makes this behavior quite robust. Consequently, because her behaviors have been successful in the past, they are nevertheless maintained by the variable, but infrequent reinforcement they produce. Lydia describes this as being perseverant, which is similar to gambling, in which “one more try” is predicted to be the winning one. It is one explanation for why people persist with a behavior that is no longer helpful.

Another way the development of chronic pain might be progressed is through unwarranted generalization. Generalization occurs when people extrapolate knowledge from one situation to another without actually having experienced that other situation. This is an important feature of learning because people do not have to learn all possible associations one by one. Treatment aims to generalize new behaviors—such as exercising or relaxation training learned at the clinic—to other settings, such as

the home. With too little generalization, people may struggle; however, there can also be too *much* generalization. In the case of avoidance behavior, for example, a patient may begin to avoid more and more situations.

In the case of pain, generalizing safe and dangerous conditions is of special importance and they help to form people’s beliefs. Although avoiding a very heavy lift might keep us safe, avoiding all lifting can have the opposite effect. In fact, patients with fibromyalgia tend to generalize pain-related fear responses to novel stimuli,⁶⁴ and this fear also enhances the generalization of pain to other body parts.⁶⁵ Many “pain beliefs” articulate the conditions for generalization. Recent evidence shows that certain movements are avoided, not because they are harmful, but rather because they are generalized into a category of believed “dangerous” movements.⁶⁶ Problem solving may assist in challenging “rigid” responses and beliefs and to increase flexibility.^{8,67}

Lydia generalized her responses to a number of situations, even beyond those being beneficial. Although some responses (eg, resting) may be helpful in specific situations (eg, acute bout of pain), she now uses them in numerous other situations. This is fueled by the emergence of beliefs based on generalizations from actual associations (eg, “it is dangerous to sit too long” or “each repetitive movement deteriorates my back”). These beliefs increase negative affect and muscle tension, which in turn can increase the pain intensity and enhance the other co-occurring problems. Moreover, Lydia has generalized

Etiology of Chronic Pain

Table 2.

Overview of Predictions That Can Be Made From the Model According to Each Tenet

Tenet	Predictions	Clinical Application ^a
Developmental process	<p>Patients will have different developmental trajectories.</p> <p>Trajectories can be identified relatively early on.</p> <p>There will be many windows for intervention.</p> <p>Ignoring high-risk trajectories will not be helpful.</p> <p>Early interventions for high-risk trajectories will produce a better clinical outcome than those initiated later on.</p>	<p>View pain problems as developing over time.</p> <p>Early identification and intervention are central.</p>
Contextual factors	<p>Sensitivity to context is a protective factor.</p> <p>Context-insensitive pain responses will result in increased pain-related disability and emotions that will contribute to the development of the problem.</p> <p>Training context sensitivity (eg, discrimination training) will improve the treatment effect.</p>	<p>Context is a powerful determinant. Training sensitivity to key contextual cues is essential to improving outcome.</p>
Transdiagnostic factors	<p>Psychological processes that drive co-occurring problems can be identified.</p> <p>Treatments targeting transdiagnostic factors will reduce co-occurring problems.</p> <p>Targeting transdiagnostic factors will be more effective than general or nonspecific (nontargeted) treatments.</p> <p>There are common modes of treatment (eg, communication) that will be effective because they are transdiagnostic in nature (ie, address transdiagnostic factors).</p>	<p>Identify processes that drive comorbid problems and target them in the treatment.</p>

^aSummary of how the model can be applied in clinics.

her avoidance behavior to deal with her co-occurring depression and worry, which inadvertently contributes to dysfunction and depression. Lydia's ability to discriminate external cues is also reduced by the intense internal cues (fear, pain) that demand her attention. Caroline, in contrast, is responding to the cues as they change and she thereby adjusts her responses appropriately.

Extinction: Relapse and the Paradox

The continuation of responses to control pain that paradoxically maintain the problem are also related to relapses after treatment. Certain responses like avoidance have a notorious propensity to re-appear.^{68,69} When avoidance is effective, there is little opportunity to extinguish the behavior because the consequences of not avoiding never occur. The effect of hearing the buzz without the sting (a fly instead of a bee) is always averted by the avoidance, so a new association (buzz-no sting) cannot be learned. This phenomenon underscores the law that once an association is learned it will not "disappear" with extinction. Instead, it must be "replaced" by a competing association⁵⁵ meaning the "old" association can easily be elicited.⁶⁸

The challenge of extinguishing responses is quite relevant for explaining the development of Lydia's pain problem. For example, Lydia attempted to work at home where she had a different chair and work station. However, this created a new context and triggered a renewal effect with fear and muscle contractions. She also attempted to return to her usual work place after a period of being off on sick leave. Once she came into her work area and sat down at the station this was a new presentation of the conditioned stimulus resulting in rapid reacquisition. Caroline remained at work and although she had modified duty was exposed to the usual cues at work, thus avoiding the return of the response. Moreover, Caroline experienced her pain as being more controllable and gradually dissipating with time, thus eliminating reexposure.

Applying the Tenets to a Hypothesis-Driven Agenda for Application in Clinics and Research

In this section, we discuss possible ways of providing better care and groundbreaking research by deriving postulates from the tenets that can be tested.⁷⁰⁻⁷⁴ To this end, Table 2 presents

our tenets with examples of important hypotheses derived from them and a summary of key principles, whereas Table 3 focuses on application in clinics. Although we make no claim that all of the suggested routines are new, we do assert that they are derived from the tenets and make good clinical sense for physical therapists and other clinicians as well.

Clinical Predictions

A central hypothesis in Table 2 is that patients who are on a trajectory toward a chronic problem can be identified very early on by targeting psychological factors. This is because such transdiagnostic processes begin influencing the problem even before the patient seeks health care services.⁷¹ Therefore, although usual "physical" assessment including red flags may suffice for Caroline, it will likely fail for Lydia because it misses the developmental timeline and the psychosocial risk factors. This can be unfortunate because treatment may be misdirected and the drivers of chronicity are given more time to operate. In Table 2, we assert that it is possible to identify patients who begin to cross the "paradoxical border" of a behavior being adaptive to not being adaptive already at the first health care visit.^{67,72}

Table 3.
Overview of Application of Tenets in Clinics^a

Usual Approach	Application of Model for Lydia	Tenet(s) Involved
Patient is assessed medically, with a focus on pain and injury.	In addition to physical examination:	
	Assess the time line (Is the pain recurrent? Is there progression toward chronicity?).	Developmental
	Assess learning history and current context.	Learning and Transdiagnostic
	Assess psychosocial factors (ie, "risk factors").	Transdiagnostic
	Further assess transdiagnostic factors and context (eg, work, family).	Context and Transdiagnostic
Treatment is aimed at pain relief, reassurance, and advice to exercise.	During treatment:	
	Address underlying transdiagnostic factors to deal with problem as a whole.	Transdiagnostic
	Develop personally relevant goals that focus on function and are overarching.	Learning
	Treat patient's worry, catastrophizing, and avoidance directly by using context sensitivity and learning principles.	Context and Learning
Patient is informed to expect to get better quickly (eg, 2–3 wk). If not better, patient should contact provider.	Posttreatment:	
	Communicate that flare-ups and recurrence are the rule (not the exception).	Developmental
	Create context that supports adaptive behaviors.	Context
	Prepare Lydia for recurrent bouts.	Developmental
	Follow-up and support are necessary to maintain treatment effects.	Learning

^aIllustrating how Lydia's case might be handled differently from Caroline's case.

This assessment may utilize screening instruments that assist clinicians in examining psychosocial risk factors (ie, "yellow flags"). For example, the Örebro Musculoskeletal Pain Screening Questionnaire (ÖMPSQ)⁷³ provides clear cutoffs concerning the level of risk that may be helpful, as physical therapists may not believe they can predict which patients are at risk.⁷⁴ The screening tool is used as an adjunct then, and it provides clinically useful information to conceptualize the case and select appropriate treatment regimens.^{75,76} Table 2 also underscores that transdiagnostic psychosocial factors that are driving the problem need to be identified and addressed in treatment (see below). More research on how transdiagnostic factors work will help to further develop the available screening tools.

Given the variety of transdiagnostic processes operating and the developmental perspective, we also hypothesize that there are many different time points when successful intervention is possible. Above all, the tenets predict that because the problem would be less complex and the learning history shorter, then interventions at earlier time points should be more effective

than those occurring later on. In fact, we have shown that short interventions even before a person is seeking care can be of value.^{25,77} However, there is a true need for research on interventions that target transdiagnostic factors, but are sensitive to the developmental time line.

Because recurrence of pain episodes is the rule rather than the exception, we postulate that the role of follow-up is crucial for maintaining and enhancing outcome. Patients may be told to expect to get better quickly, but if they do not, to seek care. Although this might be satisfactory for Caroline, it could be devastating for Lydia. Because Lydia is worried and experiences the pain as unpredictable and uncontrollable, such advice would increase her attention toward the pain and her worry about symptoms, and it would maintain her avoidance behaviors. The context for when she may safely engage in activities is unclear to her and this propels avoidance. Our model implies that Lydia needs to expect and be prepared for flare-ups and setbacks because they are naturally occurring. Given its importance, there is a dismaying lack of research tying individual patients to

when, how, and with what content follow-up sessions should be conducted.

Our transdiagnostic tenet hypothesizes that comorbid problems associated with chronic pain are chiefly related to the same factors as the pain problem itself. Although there is no transdiagnostic treatment available for pain, there is evidence that a transdiagnostic "unified protocol" is successful for complex anxiety and depression disorders^{51,78–80} and that transdiagnostic factors may explain typical problems co-occurring with pain.^{46,48,81,82} A challenge for the future is to develop and test a transdiagnostic protocol for pain. We predict that the effect size of treatment will be directly related not to the amount of treatment provided, but rather to the extent to which the treatment addresses transdiagnostic factors.

Although the principles of learning have been utilized in cognitive-behavioral and "third-wave" therapies for pain, outcomes could be enhanced further by new innovations in their application.⁸³ Future research needs to ensure generalization to key situations (eg, the home and workplace). We predict that incorporating contextual

factors into treatment will improve generalization.

Clinical Application: Helping Lydia

After considering the tenets, we wondered how practicing physical therapists or other clinicians might better serve Lydia's needs by applying knowledge about etiology. To highlight application, Table 3 compares how "typical" clinical routines contrast with those derived from the tenets. Although the suggested application may be quite a different approach for some clinicians, it can also be seen as a compliment to traditional professional skills and a way to improve treatment. The table highlights 3 key aspects. First, there is a focus on an early assessment in order to understand fully the etiology and possible underlying transdiagnostic psychosocial factors. Patients (eg, Lydia) who risk developing chronic disability because of psychosocial factors are identified and understood. This may be accomplished with screening (see above) as well as with interviews. Second, for patients at risk, the identified factors should be directly addressed. This means addressing the fears, worries, and concerns Lydia has. It also means developing goals that are relevant to Lydia (eg, leisure, social, and work activities) and developing a treatment to help her achieve these. The principles of learning can be utilized to enhance this. We suggest that exposure training for fear-avoidance or cognitive-behavioral therapy for depression will be more successful than indirect methods, such as analgesics or manipulation, that mainly aim to reduce pain. In essence, this also helps train context sensitivity, the right response for the situation. Third, Table 3 emphasizes shaping Lydia's expectations. Flare-ups are common and can be dealt with using a number of skills. Helping Lydia develop and apply these skills will increase her ability to deal with flare-ups and boost her self-confidence. This also promotes context sensitivity by helping Lydia learn to discriminate the cues for initiating the skills. Providing follow-ups and support may also be helpful. In short, the methods derived provide an emotional component that can be especially

helpful and necessary in order to help Lydia deal with her problem and thereby prevent chronic disability from developing.

Recapitulation

We have delineated 4 tenets designed to enhance current understanding of the etiology of chronic pain-related disability and explain why a problem may develop for one person (Lydia), but not another (Caroline). We are humble in acknowledging that there are numerous mysterious yet to be solved. Although the road to elucidating the etiology of chronic pain disability is long, our tenets are meant to provide a platform from which to launch new initiatives. We hope that they foster the true "scientist-practitioner" and the integration of research and clinical applications for the advancement of the field.

Author Contributions

Concept/idea/research design: S.J. Linton, I. K. Flink, J.W.S. Vlaeyen

Writing: S.J. Linton, I.K. Flink, J.W.S. Vlaeyen

Project management: S.J. Linton

Consultation (including review of manuscript before submitting): I.K. Flink

Funding

This work was supported in part by grants from Vetenskapsrådet, Riksbanken, and Örebro University. J.W.S. Vlaeyen is supported by the "Asthenes" long-term structural funding Methusalem grant from the Flemish Government, Belgium. The funders played no role in the writing of this Perspective.

Disclosures

The authors completed the ICJME Form for Disclosure of Potential Conflicts of Interest. They reported no conflicts of interest.

DOI: 10.1093/ptj/pzy027

References

- 1 Breivik H, Collett B, Ventafridda V, Cohen R, Gallacher D. Survey of chronic pain in Europe: prevalence, impact on daily life, and treatment. *Eur J Pain*. 2006;10:287–333.
- 2 Hoy DG, Bain C, Williams G, et al. A systematic review of the global prevalence of low back pain. *Arthritis Rheum*. 2012;64:2028–2037.

- 3 Dagenais S, Caro J, Haldeman S. A systematic review of low back pain cost of illness studies in the United States and internationally. *Spine J*. 2008;8:8–20.
- 4 Juniper M, Le TK, Mladsi D. The epidemiology, economic burden, and pharmacological treatment of chronic low back pain in France, Germany, Italy, Spain and the UK: a literature-based review. *Expert Opin Pharmacother*. 2009;10:2581–2592.
- 5 Collins JJ, Baase CM, Sharda CE, et al. The assessment of chronic health conditions on work performance, absence, and total economic impact for employers. *J Occup Environ Med*. 2005;47:547–557.
- 6 Lumley MA, Cohen JL, Borszcz GS, et al. Pain and emotion: a biopsychosocial review of recent research. *J Clin Psychol*. 2011;67:942–968.
- 7 Tracey I. Getting the pain you expect: mechanisms of placebo, nocebo and reappraisal effects in humans. *Nat Med*. 2010;16:1277–1283.
- 8 McCracken LM, Morley S. The psychological flexibility model: a basis for integration and progress in psychological approaches to chronic pain management. *J Pain*. 2014;15:221–234.
- 9 Moseley GL, Flor H. Targeting cortical representations in the treatment of chronic pain: a review. *Neurorehabil Neural Repair*. 2012;26:646–652.
- 10 Brooks J, Tracey I. From nociception to pain perception: imaging the spinal and supraspinal pathways. *J Anat*. 2005;207:19–33.
- 11 Waddell G. *The Back Pain Revolution*. 2nd ed. New York, NY: Churchill-Livingstone; 2004.
- 12 Henschke N, Maher CG, Refshauge KM, et al. Prevalence of and screening for serious spinal pathology in patients presenting to primary care settings with acute low back pain. *Arthritis Rheum*. 2009;60:3072–3080.
- 13 Vlaeyen JW, Crombez G, Linton SJ. The fear-avoidance model of pain. *Pain*. 2016;157:1588–1589.
- 14 Vlaeyen JWS, Linton SJ. Fear-avoidance and its consequences in chronic musculoskeletal pain: a state of the art. *Pain*. 2000;85:317–332.
- 15 Vlaeyen JWS, Linton SJ. Fear-avoidance model of chronic musculoskeletal pain: 12 years on. *Pain*. 2012;153:1144–1147.
- 16 Eccleston C, Crombez G. Worry and chronic pain: a misdirected problem solving model. *Pain*. 2007;132:233–236.
- 17 Linton SJ, Buer N. Working despite pain: factors associated with work attendance versus dysfunction. *Int J Behav Med*. 1995;2:252–262.
- 18 Frederiksen P, Karsten MMV, Indahl A, Bendix T. What challenges manual workers' ability to cope with back pain at work, and what influences their decision to call in sick? *J Occup Rehabil*. 2015;25:1–10.

- 19 Crombez G, Vlaeyen JWS, Heuts PH, Lysens R. Pain-related fear is more disabling than pain itself: evidence on the role of pain-related fear in chronic back pain disability. *Pain*. 1999;80:329–339.
- 20 Turk DC. Biopsychosocial perspective on chronic pain. In: Gatchel RJ, Turk DC, eds. *Psychological Approaches to Pain Management: A Practitioner's Handbook*. Vol 1. New York, NY: Guilford Press; 1996:3–32.
- 21 Merskey H, Bogduk N, eds. *Classification of Chronic Pain*. 2nd ed. Seattle, WA: IASP Press; 1994.
- 22 Linton SJ, Gross D, Schultz IZ, et al. Prognosis and the identification of workers risking disability. *J Occup Rehabil*. 2005;15:459–474.
- 23 Stanton TR, Latimer J, Maher CG, Hancock MJ. How do we define the condition 'recurrent low back pain'? A systematic review. *Eur Spine J*. 2010;19:533–539.
- 24 Nicholas MK, Linton SJ, Watson PJ, Main CJ. Early identification and management of psychosocial risk factors ("yellow flags") in patients with low back pain: a reappraisal. *Phys Ther*. 2011;91:737–753.
- 25 Linton SJ, Boersma K, Traczyk M, Shaw W, Nicholas M. Early workplace communication and problem solving to prevent back disability: results of a randomized controlled trial among high-risk workers and their supervisors. *J Occup Rehabil*. 2016;26:150–159.
- 26 Hill JC, Whitehurst DGT, Lewis M, et al. Comparison of stratified primary care management for low back pain with current best practice (STarT Back): a randomised controlled trial. *Lancet*. 2011;378:1560–1571.
- 27 Wurm M, Edlund S, Tillfors M, Boersma K. Characteristics and consequences of the co-occurrence between social anxiety and pain-related fear in chronic pain patients receiving multimodal pain rehabilitation treatment. *Scand J Pain*. 2016;12:45–52.
- 28 Van Damme S, Crombez G, Eccleston C. Coping with pain: a motivational perspective. *Pain*. 2008;139:1–4.
- 29 Linton SJ. Why does chronic pain develop? A behavioral approach. In: Linton SJ, ed. *New Avenues for the Prevention of Chronic Musculoskeletal Pain and Disability*. Amsterdam, the Netherlands: Elsevier Science; 2002:67–82.
- 30 Mineka S, Zinbarg R. A contemporary learning theory perspective on the etiology of anxiety disorders: it's not what you thought it was. *Am Psychol*. 2006;61:10–26.
- 31 Hussey JM, Chang JJ, Kotch JB. Child maltreatment in the United States: prevalence, risk factors, and adolescent health consequences. *Pediatrics*. 2006;118:933–942.
- 32 Linton SJ. What do maltreatment and schemas have to do with the treatment of chronic pain?: commentary on 'Early maladaptive schemas in Finnish men and women with chronic pain.' *Scand J Pain*. 2010;1:193–195.
- 33 Linton SJ. A prospective study of the effects of self-reported physical and sexual abuse on the development of musculoskeletal pain. *Pain*. 2002;96:347–351.
- 34 Davis DA, Luecken LJ, Zautra AJ. Are reports of childhood abuse related to the experience of chronic pain in adulthood?: A meta-analytic review of the literature. *Clin J Pain*. 2005;21:398–405.
- 35 Coifman KG, Bonanno GA. Emotion context sensitivity in adaptation and recovery. In: Kring AM, Sloan DM, eds. *Emotion Regulation and Psychopathology: A Transdiagnostic Approach to Etiology and Treatment*. New York, NY: The Guildford Press; 2010:157–173.
- 36 Linton S, Flink IK, Schrooten MGS, Wicksell R. Understanding co-occurring emotion and pain: the role of context sensitivity from a transdiagnostic perspective. *J Contemp Psychother*. 2016;46:129–137.
- 37 Bonanno GA, Colak DM, Keltner D, et al. Context matters: the benefits and costs of expressing positive emotion among survivors of childhood sexual abuse. *Emotion*. 2007;7:824–837.
- 38 Linton SJ, Fruzzetti A. A hybrid emotion-focused exposure treatment for chronic pain: a feasibility study. *Scand J Pain*. 2014;5:151–158.
- 39 Aldao A. The future of emotion regulation research capturing context. *Perspect Psychol Sci*. 2013;8:155–172.
- 40 Linton SJ, Flink IK, Schrooten MG, Wicksell R. Understanding co-occurring emotion and pain: the role of context sensitivity from a transdiagnostic perspective. *J Contemp Psychother*. 2016;46:129–137.
- 41 Bonanno GA, Papa A, Lalande K, Westphal M, Coifman KG. The importance of being flexible: the ability to both enhance and suppress emotional expression predicts long-term adjustment. *Psychol Sci*. 2004;15:482–487.
- 42 Aldao A, Nolen-Hoeksema S. The influence of context on the implementation of adaptive emotion regulation strategies. *Behav Res Ther*. 2012;50:493–501.
- 43 Aldao A, Nolen-Hoeksema S, Schweizer S. Emotion-regulation strategies across psychopathology: a meta-analytic review. *Clin Psychol Rev*. 2010;30:217–237.
- 44 Crombez G, Viane I, Eccleston C, Develulder J, Goubert L. Attention to pain and fear of pain in patients with chronic pain. *J Behav Med*. 2013;36:371–378.
- 45 Eccleston C, Crombez G. Pain demands attention: a cognitive-affective model of the interruptive function of pain. *Psychol Bull*. 1999;125:356–366.
- 46 Linton SJ. A transdiagnostic approach to pain and emotion. *J Appl Biobehav Res*. 2013;18:82–103.
- 47 Bair MJ, Robinson RL, Katon W, Kroenke K. Depression and pain comorbidity. *Arch Intern Med*. 2003;163:2433–2445.
- 48 Tang NK, Goodchild CE, Webster LR. Sleep and chronic pain. In: Deer TR, Leong MS, Buvanendran A, eds. *Comprehensive Treatment of Chronic Pain by Medical, Interventional, and Integrative Approaches*. New York, NY: Springer-Verlag; 2013:947–962.
- 49 Harvey A, Watkins E, Mansell W, Shafran R. *Cognitive Behavioural Processes Across Psychological Disorders: A Transdiagnostic Approach to Research and Treatment*. Oxford, England: Oxford University Press; 2004.
- 50 Mansell W, Harvey A, Watkins E, Shafran R. Conceptual foundations of the transdiagnostic approach to CBT. *J Cogn Psychother*. 2009;23:6–19.
- 51 Mansell W, Harvey A, Watkins ER, Shafran R. Cognitive behavioral processes across psychological disorders: a review of the utility and validity of the transdiagnostic approach. *Int J Cogn Ther*. 2008;1:181–191.
- 52 Besen E, Gaines B, Linton SJ, Shaw WS. The role of pain catastrophizing as a mediator in the work disability process following acute low back pain. *J Appl Biobehav Res*. 2017 March 24 [E-pub ahead of print]. doi: 10.1111/jabr.12085.
- 53 Eccleston C. A normal psychology of pain. *Pain Manag*. 2011;1:399–403.
- 54 Bouton ME. *Learning and Behavior: A Contemporary Synthesis*. Sunderland, MA: Sinauer Associates; 2007.
- 55 Craske MG, Treanor M, Conway CC, Zbozinek T, Vervliet B. Maximizing exposure therapy: an inhibitory learning approach. *Behav Res Ther*. 2014;58:10–23.
- 56 Meulders A, Vlaeyen JW. Mere intention to perform painful movements elicits fear of movement-related pain: an experimental study on fear acquisition beyond actual movements. *J Pain*. 2013;14:412–423.
- 57 Fordyce WE. *Behavioral Methods for Chronic Pain and Illness*. St Louis, MO: Mosby; 1976.
- 58 Main CJ, Keefe FJ, Jensen MP, Vlaeyen JWS, Vowles KE. *Fordyce's Behavioral Methods for Chronic Pain and Illness: Republished With Invited Commentaries*. Philadelphia, PA: Wolters Kluwer; 2015.
- 59 Linton SJ, Gøttestam KG. Controlling pain reports through operant conditioning: a laboratory demonstration. *Percept Mot Skills*. 1985;60:427–437.
- 60 Lousberg R, Vuurman E, Lamers T, et al. Pain report and pain-related evoked potentials operantly conditioned. *Clin J Pain*. 2005;21:262–271.
- 61 Jolliffe CD, Nicholas MK. Verbally reinforcing pain reports: an experimental test of the operant model of chronic pain. *Pain*. 2004;107:167–175.
- 62 Skinner BF. *Contingencies of Reinforcement: A Theoretical Analysis*. Vol 3. Cambridge, MA: BF Skinner Foundation; 2014.

Etiology of Chronic Pain

- 63 Crowe M, Whitehead L, Gagan MJ, Baxter GD, Pankhurst A, Valledor V. Listening to the body and talking to myself: the impact of chronic lower back pain—a qualitative study. *Int J Nurs Stud*. 2010;47:586–592.
- 64 Meulders A, Jans A, Vlaeyen JW. Differences in pain-related fear acquisition and generalization: an experimental study comparing patients with fibromyalgia and healthy controls. *Pain*. 2015;156:108–122.
- 65 Niederstrasser NG, Meulders A, Meulders M, Struyf D, Vlaeyen J. Pain catastrophizers overgeneralize and low inhibitory capacity impedes the extinction of generalized fear of movement-related pain. In: Proceedings from the Pain Research Meeting; September 24–25, 2015; Genk, Belgium.
- 66 Bennett MP, Meulders A, Baeyens F, Vlaeyen JW. Words putting pain in motion: the generalization of pain-related fear within an artificial stimulus category. *Front Psychol*. 2015;6:520.
- 67 Linton SJ, Boersma K, Traczyk M, Shaw W, Nicholas M. Early workplace communication and problem solving to prevent back disability: results of a randomized controlled trial among high-risk workers and their supervisors. *J Occup Rehabil*. 2016;26:150–159.
- 68 Bouton M. Context and behavioral processes in extinction. *Learn Mem*. 2004;11:485–494.
- 69 Hofmann SG. Cognitive processes during fear acquisition and extinction in animals and humans: implications for exposure therapy of anxiety disorders. *Clin Psychol Rev*. 2008;28:199–210.
- 70 Vlaeyen JWS. Psychological flexibility: what theory and which predictions? *J Pain*. 2014;15:235–236.
- 71 Lee H, Hübscher M, Moseley GL, et al. How does pain lead to disability? A systematic review and meta-analysis of mediation studies in people with back and neck pain. *Pain*. 2015;156:988–997.
- 72 Bergström G, Hagberg J, Busch H, Jensen I, Björklund C. Prediction of sickness absenteeism, disability pension and sickness presenteeism among employees with back pain. *J Occup Rehabil*. 2014;24:278–286.
- 73 Linton SJ, Boersma K. Early identification of patients at risk of developing a persistent back problem: the predictive validity of the Örebro Musculoskeletal Pain Questionnaire. *Clin J Pain*. 2003;19:80–86.
- 74 Beales D, Kendell M, Chang R, et al. Association between the 10 item Örebro Musculoskeletal Pain Screening Questionnaire and physiotherapists' perception of the contribution of biopsychosocial factors in patients with musculoskeletal pain. *Man Ther*. 2016;23:48–55.
- 75 Brown G. The Örebro Musculoskeletal Pain Questionnaire. *Occup Med*. 2008;58:447–448.
- 76 Gross DP, Armijo-Olivo S, Shaw WS, et al. Clinical decision support tools for selecting interventions for patients with disabling musculoskeletal disorders: a scoping review. *J Occup Rehabil*. 2016;26:286–318.
- 77 Linton SJ, Ryberg M. A cognitive-behavioral group intervention as prevention for persistent neck and back pain in a non-patient population: a randomized controlled trial. *Pain*. 2001;90:83–90.
- 78 McEvoy PM, Nathan P, Norton PJ. Efficacy of transdiagnostic treatments: a review of published outcome studies and future research directions. *J Cogn Psychotber*. 2009;23:20–33.
- 79 Farchione TJ, Fairholme CP, Ellard KK, et al. Unified protocol for transdiagnostic treatment of emotional disorders: a randomized controlled trial. *Behav Ther*. 2012;43:666–678.
- 80 Ellard KK, Fairholme CP, Boisseau CL, Farchione TJ, Barlow DH. Unified protocol for the transdiagnostic treatment of emotional disorders: protocol development and initial outcome data. *Cogn Behav Pract*. 2010;17:88–101.
- 81 Linton SJ, Bergbom S. Understanding the link between depression and pain. *Scand J Pain*. 2011;2:47–54.
- 82 Asmundson GJG, Katz J. Understanding the co-occurrence of anxiety disorders and chronic pain: state-of-the-art. *Depress Anxiety*. 2009;26:888–901.
- 83 Harvey AG, Lee J, Smith RL, et al. Improving outcome for mental disorders by enhancing memory for treatment. *Behav Res Ther*. 2016;81:35–46.