



Pain and the field of affordances: an enactive approach to acute and chronic pain

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Abstract

In recent years, the societal and personal impacts of pain, and the fact that we still lack an effective method of treatment, has motivated researchers from diverse disciplines to try to think in new ways about pain and its management. In this paper, we aim to develop an enactive approach to pain and the transition to chronicity. Two aspects are central to this project. First, the paper conceptualizes differences between acute and chronic pain, as well as the dynamic process of pain chronification, in terms of changes in the field of affordances. This is, in terms of the possibilities for action perceived by subjects in pain. As such, we aim to do justice to the lived experience of patients as well as the dynamic role of behavioral learning, neural reorganization, and socio-cultural practices in the generation and maintenance of pain. Second, we aim to show in which manners such an enactive approach may contribute to a comprehensive understanding of pain that avoids conceptual and methodological issues of reductionist and fragmented approaches. It proves particularly beneficial as a heuristic in pain therapy addressing the heterogenous yet dynamically intertwined aspects that may contribute to pain and its chronification.

Keywords Affordances · Biopsychosocial · Ecological psychology · Existential feelings · Phenomenology · Pain therapy

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1 Introduction

Pains are among the most fundamental experiences that we undergo in everyday life. Many of us know the unpleasant burning sensation when accidentally touching a hot plate or the agonizing ache of a fracture. One of the peculiarities that makes pain such a fascinating and at the same time frustrating object of research is that it is one of the rare conditions commonly characterized solely in terms of *what it is like* for a subject to undergo a corresponding experience (Nagel, 1974). This is of relevance as scientists have failed to identify an objective criterion, such as a certain physiological cause, brain state, or functional role that allows us to unequivocally identify pain across conditions and samples (Coninx, 2020a; Stilwell & Harman, 2019). Pain is a subjective experience that cannot be considered independent of an individual's perspective (Raja et al., 2020), not least for legal and ethical reasons.

Pain constitutes a fundamental part of our life and provides substantial biological benefit, particularly due to its intimate link to action (Coninx, 2020b; Klein, 2015). This is especially true for *acute pains* that have a relatively short duration and are typically associated with concrete injuries (e.g. burn or fracture pain), illnesses (e.g. body aches related to a flu), or homeostatic imbalances (e.g. headaches related to dehydration). Such pains allow subjects to identify threats and adapt to their current situation in order to protect, maintain, and recover their bodily integrity (Vlaeyen et al., 2016). For example, in withdrawing one's hand from a hot plate, we avoid further or potential injury, and in avoiding bearing weight on a broken bone, we promote recuperation. Pain experiences might be hurtful, and we might prefer to avoid them, but a life without the ability to experience pain is highly problematic.

By contrast, *chronic pains* are commonly defined as pains that remain after a common healing phase of about three to six months, though the respective time span might differ across conditions (Apkarian et al., 2009). Most importantly, chronic pains are not just acute pains that have failed to stop until a particular point in time (Hardcastle, 2014). The process of chronification is fluid and primarily reflected in its effects on affected patients (Stilwell & Harman, 2019). Recently, chronic primary pain was added to the International Classifications of Diseases (ICD-11), emphasizing that chronic pain can be classified as a disease in its own right (Treede et al., 2019). One of the central goals of pain research is to gain a better understanding of chronic pain and, building on this, the development of more effective therapeutic measures. This seems particularly pressing as chronic pain affects on average about 20% of the adult population (Breivik et al., 2006; Dahlhamer et al., 2018).

The significant impact of chronic pain, and the fact that we still lack an effective method of treatment, motivate researchers from diverse disciplines (including us) to try to think in new ways about pain and pain therapy. Two questions are central to such project. (i) *Static Question*: how do acute and chronic pains differ from one another besides their temporality? Answering this question means to directly compare occurrences of acute and chronic pains in order to reveal

relevant differences among the properties they instantiate. (ii) *Dynamic Question*: how does acute pain transform into chronic pain? This question targets the process of transition from acute to chronic pain (i.e. the generation and maintenance of chronic pain). Answering this question would allow us to understand what goes ‘wrong’ in the chronification of pain while offering at the same time possible starting points for interventions.

In this paper, we aim to develop an *enactive approach* to acute and chronic pain. The paper focuses on a conceptualization of pain in terms of affordances, i.e. perceived possibilities for action, while integrating central aspects from the phenomenal-existentialist and the ecological tradition. Thereby, we aim to outline a framework that does justice to the perspective of concerned patients as well as the interactive embodied relation between subject and environment which shapes the different ways pain is experienced. Without aiming to prove the superiority of an enactive approach over alternatives in the general conceptualization of the mind, we want to emphasize the advantages of the outlined framework as a useful heuristic in the analysis of pain and its treatment. Thus, our goal is to show that the enactive framework provides a conceptual and methodological toolbox useful in clinical contexts of pain research and management.

Our approach is in line with a promising trend in the enactive discourse on psychopathologies that has gained popularity in recent years (e.g. de Haan et al., 2013; de Haan, 2020a; Glackin et al., 2020; Krueger & Colombetti, 2018). So far, the literature is sparse on the question of how enactive approaches can contribute to better understanding pain and inform therapeutic approaches. Our paper aims to fill this gap. The paper proceeds as follows. In Sect. 2, we introduce the concepts and methods that we consider most central to integrate in the development of an enactive approach to pain. In Sect. 3, we address the static and dynamic question in an enactive framework. In Sect. 4, we outline how these considerations can be integrated in clinical application with a focus on pain treatment and management. Section 5 summarizes our considerations.

2 Concepts and methods: perspectives on the field of affordances

The aim of this section is to provide the conceptual and methodological background for the envisaged enactive account of pain. First, we outline the theoretical starting point of our project and introduce main concepts with a focus on the field of affordances. Second, we introduce the dimensions that we consider to constitute the field of affordances. Third, we highlight the advantages that an enactive framework might offer in the investigation of pain. Fourth, we discuss the central methodology that we apply in the upcoming sections.

2.1 Main concepts

We consider our approach as *enactive* as we think about pain and the process of chronification in terms of alterations in the dynamic, interactive, and embodied

relation between subjects and their environment (e.g. Varela et al., 1991). An enactive framework seems particularly suited to approach how subjects experience themselves and their environment from the perspective of bodily beings that relate and attune to such environment based on their skills and concerns. Throughout the paper, we refer to the dynamic process of relating and interacting as an individual's 'stance' towards oneself and the world.

We rely on a recent trend in the literature integrating into an enactive framework core aspects of the *ecological tradition* (e.g. Rietveld et al., 2019) as well as the *phenomenal-existential tradition* (e.g. de Haan, 2020a), i.e. two traditions that are themselves historically and conceptually intertwined (Käufner & Chemero, 2015). While enactive theories focus on the perspective of subjects acting upon the world, ecological approaches often select the opposite starting point describing how the structure of the world shapes the subject's possibility to act (Baggs & Chemero, 2018). The phenomenal-existential tradition (e.g. Merleau-Ponty, 1962) blends in with this image in highlighting the lived body with its skills, habits, and dispositions as the medium through which subjects engage with the world. Taken together, we consider three complementary aspects as central for an enactive approach to pain: (i) a subject's active engagement with the world and their perceived possibilities to act, (ii) the dynamic bi-directional relation between subjects and their environment mediated by the body, and (iii) the lived experience of subjects and their transformative potential.¹

At the center of our framework is the idea of a 'field of affordances' which will be defined shortly. Gibson (1986) coined the term *affordances* for the opportunities for behavior that the environment offers the members of certain species that are able to recognize and respond to them. Many accept that affordances depend on an organism's abilities as well as the environment's conditions, while being neither properties of the organism nor the environment (Chemero, 2003). Leaving aside ontological debates, analyzing phenomena in terms of affordances offers a way to highlight

¹ Please note that enactivism appears in various flavors while many concepts and claims are still subject of ongoing debate (e.g. Newen et al., 2018). There is no single form of enactivism with assumptions that any enactivist theory would have to subscribe to. It is not our goal to defend a particular strand of enactivism, though we consider the integration of core aspects of the ecological and phenomenal-existential tradition as fruitful (see also de Haan et al., 2013). In particular, we do not aim to be engaged in debates on the ontological status of pain claiming, for example, that it extends beyond the brain. Our aim is to present an enactive conceptualization of pain that proves promising in its (clinical) application irrespective of whether the corresponding dynamic relation between brain, body, and environment is constitutive or based on intimate causal coupling. We consider this to be aligned with the enactivist tradition which is compatible with but not committed to the extended mind thesis (e.g. Colombetti, 2018). We understand enactivism in the first place as a lens that allows us to reconsider a certain phenomenon from a new perspective. Most importantly, even if one accepts that the minimal constitutive base of experiences such as pain is the brain, one may acknowledge that the characteristic manner of what it is like for subjects to undergo such experiences depends on the embodied interactive relation between subjects and their environment (Hutto & Myin, 2012). Thus, in this paper, we aim to emphasize the epistemological inseparability of brain, body, and environment (Varga, 2019). That is, researchers must exceed the brain for a comprehensive analysis of the nature of pain and the development of effective therapies. This general approach is imposed by the nature of our research subject and will be outlined in more detail in the following.

and investigate the interactive relation between an embodied organism and the environment. Imposed by the nature of our research topic and orientation towards a clinical context, our focus is on affordances in the light of the experience of particular subjects. Further, we consider affordances to be not only associated with simple motor task or interactions with material objects in direct reach. With respect to humans, the concept of affordances might be enriched with respect to emotionally laden (Caravà & Scorolli, 2020; Krueger & Colombetti, 2018), cognitively demanding, future orientated, and socio-culturally shaped behaviors (Rietveld & Kiverstein, 2014).

Most importantly, though often underappreciated, we consider affordances as providing insights to particular individuals and their experiences in changing contexts. Only recently, this idea has received more attention leading to the assumption of a *field of affordances* (Bruineberg & Rietveld, 2014; de Haan et al., 2013) constrained by evolution, socio-cultural practice, and ontogenetic development (Gallagher, 2017) as well as an individual's current skills, interests, needs, preferences, or intentions (Dings, 2018). The field of affordances includes soliciting affordances understood as action possibilities that are relevant in a *particular* situation from the perspective of a *particular* person. The interactive relation between a subject and its environment is always idiosyncratic: different situations might call out for different actions and different subjects might be responsive to different aspects of a situation. Taken together, the field of affordances is here used to model the plurality of simultaneously perceived action possibilities relevant for a particularly skilled, concerned, and situated person.

This approach to affordances as variant action possibilities perceived by situated individuals seems required by the idiosyncratic nature of pain itself.² Another understanding of affordances, for example, as invariant action possibilities accessible to members of certain species or socio-cultural groups, independent of the existence and experience of a *particular* individual, might prove more beneficial in the context of other scientific endeavors, such as the investigation of human forms of life and their phylogenetic and cultural development (e.g. Rietveld & Kiverstein, 2014).³ However, if one aims to account for the lived experience of individual human agents and the manner in which they meaningfully construct their world and themselves, as we aim to do, it seems required to focus on the variant field of affordances and its dynamic transformation over time (Dings, 2020).

² Although experiences of pain are considered idiosyncratic, we are of course trying to make reliable statements, for example, about how acute or chronic pains typically differ across contexts or how the experience of pain is commonly shaped by certain factors across individuals and their particular situations (see Sect. 3). Generalizations of some kind are always needed in sciences to compare and transfer knowledge on a subject matter. In relying on such generalizations, one may still acknowledge that the field of affordances is subject and context variant which proves particularly relevant in pain management (see Sect. 4).

³ Such invariant action possibilities are commonly investigated as the landscape of affordances shared by members of a species and/or social-cultural group. The field of affordances is an 'excerpt' of the landscape of affordances perceived by an individual in a particular situation (e.g. de Haan et al., 2013).

In reference to the field of affordances, the self-perception of the subject in relation to a situation as well as the perception of a situation in relation to the self can be considered as two sides of the same coin, which can come into focus in different ways (de Haan et al., 2013). Subjective experiences may be constructed as different stances in the interactive relation between individuals and their environment which disclose different affordances. These stances may be described either in terms of the subject's self-perception (e.g. sensation of thirst) or the perceived change in the field of affordances (e.g. the glass of water appears salient and attractive).

2.2 Central dimensions

Before we can apply the enactive framework to the particular phenomenon of pain, we need a better understanding of the dimensions that determine the field of affordances (de Haan et al., 2013; Dings, 2018; Gallagher, 2018; Rietveld et al., 2019).⁴ For present purposes, the following four dimensions appear most important: salience, valence, mineness, and temporal horizon. These four dimensions are closely connected as all of them are in one way or another related to the perceived interactive relation between the embodied subject and their environment.

First, the affordances that the field incorporates can differ in *salience* (Rietveld et al., 2019; Rietveld & Kiverstein, 2014). Some affordances appear or are experienced as more or less relevant while subjects are more likely to respond to those affordances that are of higher salience as they exert a stronger invitation or force to act (Dings, 2018; Withagen et al., 2012). Thus, the field of affordances might dynamically shrink or expand depending on which action possibilities possess relevance for the concerned subject. Correspondingly, a subject may experience the world as more lively or silenced, and themselves as more emotionally engaged or disconnected.

Second, affordances differ in *valence* depending on whether the subject's concerns are positive or negative (Dings, 2018). Affordances can appear or be experienced as more or less relevant either because of attraction or aversion (de Haan et al., 2013, fn. 7). In common parlance, affordances seem to be associated with opportunities for action that present themselves as appealing. However, an affordance can be relevant as something either to be taken or to be avoided (Caravà & Scorolli, 2020). Affordances are conceptualized to account for the relation between subject and environment "either for good or ill" (Gibson, 1986, p. 127). The more possibilities for action open up, here understood in the sense of attractive options for action, the more the feeling of shaping the interaction with the world in an active manner arises (de Haan et al., 2013). In the contrary case when the subject is responsive to more 'negative' affordances, the world appears threatening or seems to close itself to the subject as the freedom to act and choose between positively valenced action possibilities is restricted.

⁴ Please note that the dimensions we introduce are not necessarily identical to those described by the mentioned authors, although our approach is inspired by their accounts. Thus, the same terms might be used in a (slightly) different manner.

Third, affordances can differ in perceived *mineness*. The term ‘mineness’ is commonly associated with the intimate familiarity we have with our own experiences, i.e., the irreducible minimal sense that an experience belongs to oneself (Zahavi, 2005). Our focus remains on the feeling of familiarity but with respect to the integration of affordances into a subject’s ‘psychobiography’ (e.g. Dings, 2018; Slors & Jongepier, 2014). According to this view, mineness expresses how close an affordance is experienced as being to oneself. Some affordances fit better into the general background of one’s past, simultaneous, and anticipated experiences, thoughts, and intentions, and are experienced as more integral parts of who we are. For example, running a marathon might for some merely be another challenge while for others it is a meaningful goal closely linked to their self-worth and self-image. Thus, mineness characterizes the difference between affordances that are merely relevant and those that are meaningful to the subject (Dings, 2020). Affordances with stronger mineness express an intimate relation between subject and world. Affordances with lesser mineness express a loss of such familiarity and feelings of alienation. Related to a loss in mineness is that subjects become more aware of the body as an obstacle, actions can be less easily performed without attention or effort, and the motivation to act is more and more experienced as externally imposed (Dings, 2018; Slors & Jongepier, 2014; Svenaeus, 2015).⁵

Fourth, the field of affordances can be more or less far-reaching depending on whether or not action possibilities are incorporated that appear at the *temporal horizon* reflecting the anticipated responsiveness to affordances (de Haan et al., 2013). The field of affordances can be narrowed to the here and now or integrate a wider temporal perspective providing more flexibility. Especially if many affordances of high negative valence and low mineness are incorporated and no changes in the field of affordances can be perceived with regard to the temporal horizon, feelings of hopelessness and helplessness can onset as the subject fails to see attractive possibilities for action that thaw in the proximate or distant future. That is, subjects experience themselves as trapped in an invariant world as they are becoming aware of their limitations and restrictions to engage with their environment in a dynamic and meaningful manner. In contrast, the expansion of the temporal horizon and the openness towards varying possibilities for future action can provide the opportunity to consider more actions that might not be available yet and that deviate from stiffened behavioral patterns of the past and present.

⁵ Affordances with weak mineness might still be experienced as one’s own in the sense that it is me undergoing the respective experience. What is at stake is that affordances vary with respect to their personal significance (Dings, 2018, 2020). Imagine a fervent advocator of meat eating who becomes a vegetarian. This person is very likely to still perceive the ability to eat meat as highly attractive. Nevertheless, this affordance will be of weak mineness as it is no longer close to who the person is. The bodily reactions to the smell of meat will be perceived as alien, the normally smooth interaction with the environment is disrupted as the resistance to eat meat requires effort, and the origin of the felt demand to eat meat will no longer be experienced as located in oneself.

2.3 Core motivations

More and more phenomena have been investigated in an enactive framework, including emotions (e.g. Colombetti & Thompson, 2008) and memory (e.g. Caravà, 2020). The concept of the field of affordances has been prominently investigated in the context of psychopathologies (e.g. de Haan et al., 2013; Gallagher, 2018); however, we lack application specifically to pain which appears a promising avenue of research for three reasons, at least.

First, the relation between subject and world with respect to the field of affordances is commonly considered as mediated by the responsiveness of the body (Bruineberg & Rietveld, 2014; Rietveld et al., 2019). However, pain and other bodily sensations are themselves rarely in the focus.⁶ Therefore, application to pain seems to be of utmost relevance, especially as pain, just like other bodily sensations, seems to reveal a particularly close link to action. Further, pain disrupts the normally fluid interactive relation between subject and world influencing the experience of one's own body as well as the environment (Kusch & Ratcliffe, 2018). Enactive approaches construct bodily feelings with regard to the subjects' experience of themselves and the world (de Haan et al., 2013; Dings, 2018). As such, they seem particularly suitable for dealing with the far-reaching effects of pain on subjects as well as their overall ability to interact with the world. Pain can be constructed as a subject's interactive stance towards the world to be described as an experience of the self and the body as well as of the world as it appears to the subject (see Sect. 3.1).

Second, an enactive framework enables us to address the integration problem that other approaches face (de Haan, 2020a, b). This is, to integrate the heterogeneous yet intertwined aspects that may contribute to different mental phenomena. Although different approaches (e.g. biopsychosocial model) have highlighted the role that various factors play in the generation and maintenance of psychopathological and psychosomatic disorders, for example, they too often remain silent with respect to the interrelation of these factors. The concept of the field of affordances relies on a holistic understanding of the subject as a biological organism, a member of different social communities, as well as an experiential individual trying to meaningfully construct their world and themselves (Dings, 2018, 2020). Further, the enactive framework is genuinely dynamic (Bruineberg & Rietveld, 2014): the field of affordances relies on the mutual dependence of various factors in the interactive relation between subject and world. As such, we may provide an integrative enactive framework that explicitly addresses the ongoing causal coupling between the variety of relevant factors (see Sect. 3.2).

Third, treatment approaches for pain are often fragmented and lack a unifying theoretical foundation. The genuine holistic and integrative character of the enactive framework offers unique methodological considerations when attempting to better understand and treat pain because it allows us to overcome strict distinctions

⁶ Please note that the term 'sensation' is connotated in different manners depending on the particular debate. All we commit to is that bodily sensations such as pain, itching, or thirst are certain types of subjective experiences that are typically felt as localized in the body. Subtle terminological implications that concern their causation, status as sense modalities, or the like are not intended.

between research domains that are in their practical application often difficult to maintain, phenomenally and empirically (Stilwell & Harman, 2019). Further due to its dynamic character, the enactive framework rejects an oversimplified picture of treatment acknowledging, for example, that the size of effect can be quite disproportional to the therapeutic measures as many factors interplay and interventions are sensitive to individual and contextual differences (de Haan, 2020a). There are many routes to change which are mutually dependent in facilitatory and inhibitory manners. The enactive framework may help address such complexities and dynamics by providing orientation in treatment selection, motivating interaction across research fields, and improving communication (see Sect. 4).

2.4 Domains and methods

Pain research and management has been dominated by reductionist and fragmented approaches to the conceptualization, assessment, and treatment of pain. Integrative models, such as the biopsychosocial model, are becoming more popular, but still leave much to be desired (Stilwell & Harman, 2019). In mainstream pain research and practice, reductionist models are most prevalent with an emphasis on the third-person identification of physiological processes (e.g. genetic, chemical, mechanical, or neurological) in order to provide targeted treatment. Other domains of pain are largely overlooked or deemphasized, including the following domains delineated by de Haan (2020a): experiential first-person experience, socio-cultural practice, and existential relations, i.e. the way in which people relate to and make sense of themselves and the world they inhabit, including other people.

Although some have discussed the combination of first- and third-person approaches and potential methods in the context of pain (Thacker & Moseley, 2012), in general, the four domains (physiological, experiential, sociocultural, and existential) are still all too often entertained partly or independently in pain research and clinical practices. Research methods in the physiological domain are typically quantitative, such as *in vivo* and *in vitro* electrophysiological studies, neuroimaging, or behavioral testing. The sociocultural domain is often studied using naturalistic observation, surveys, focus groups, and qualitative interviews. The experiential and existential domains are best assessed using qualitative approaches, such as semi-structured interviews exploring participants' subjective perspectives and experiences. Rarely are these diverse methods integrated in pain research, and clinical approaches often only superficially explore and address the socio-cultural, experiential, and existential domains.

An enactive framework motivates a more holistic, integrative, and dynamic approach (de Haan, 2020a). The physiological, experiential, socio-cultural, and existential domains cannot be simply opposed or reduced to each other as they refer to cross-cutting processes of rather local or global character. When studying pain, we can address processes of different domains by zooming in or out. One can focus on rather local processes such as neurological changes (as is commonly done in pain research and practice), more global processes such as subjects' experience of their relation to the world (as highlighted by the phenomenal-existential tradition), or processes that refer to an even larger socio-cultural domain (as addressed in the

investigation of cultural narratives and practices). Moreover, the enactive framework acknowledges that there is mutual influence across these domains: physiological, experiential, socio-cultural, and existential processes are continuously conditioned by each other in more or less extended feed-back loops.

Given our research subject and interest, we are concerned with individual pain patients, their acute interaction with the world, and the process of pain chronification. In this context, the reciprocal interaction between the different domains, i.e. more local or global processes, is evident. For example, subjective experiences stand in a reciprocal relation to physiological processes in the brain or body. Features of the socio-cultural environment shape subjects' physiological constitution (Hutto et al., 2020), while such environment depends on how we engage with it based in turn on experiential or existential aspects. Thus, there is no linear sequence of causation, rather, processes of the different domains interact in complex dynamic ways over time (de Haan, 2020a): none of the domains function simply like a uni-directional switch that triggers processes in another domain.⁷

In pain research, more global processes with a prioritization of the affected individual and their lived experiences have a unique status in that people have an epistemic privilege: subjective report is the best available proxy to infer that someone is experiencing pain (Stilwell & Harman, 2019). However, all domains and their interaction need to be considered to develop a comprehensive approach to pain and pain therapy. None of the domains are in principle more relevant or fundamental and research on a single domain within a particular time span is most likely insufficient to accommodate all scientific interests (see also Varga, 2019). With respect to our research interest, we advocate that a fully comprehensive approach to pain, and especially its treatment, needs to *integrate* insights from *all* domains, including qualitative and quantitative pain-related data, in accounting for their *dynamic* bi-directional interactions. Thus, we argue for a holistic, integrative, and dynamic, i.e. an enactive methodology as most promising.

We consider our framework to complement and build on the biopsychosocial model. Although the biopsychosocial model, as originally proposed (Engel, 1977), constitutes a novel framework that advanced our understanding of health and illness, it has been widely applied in a misguided manner, i.e. it has been biomedicalized, fragmented, and used in reductionist and linear ways. That is, among others, due to the fact that the original biopsychosocial model remains vague and does not provide a theoretical foundation that addresses how the various factors involved relate to each other. Engel (1980) only briefly discussed systems theory and “information flow” across systems. In contrast, we present a first sketch of the required theoretical foundation for pain research and treatment by acknowledging the heterogeneity of involved factors, their non-linear relation, and the need for integrative therapeutic measures (see also de Haan, 2020b). Furthermore, the previously outlined enactive

⁷ Please note that the particular kind of interaction may vary between the domains. For example, according to de Haan (2020a), there is an asymmetry in that more global processes necessarily include more local processes; however, not all changes in more local domains involve or ‘add up’ to changes in more global domains. This applies to the relation of the sociocultural to the existential and experiential domain, as well as of the existential and experiential to the physiological domain.

framework enables us to emphasize the lived embodied experience of concerned subjects and the centrality of their perceived possibility to act, two aspects which have been largely ignored in more traditional approaches.

In the following sections, we indicate how insights from different domains might fruitfully contribute to addressing the static and dynamic questions, as previously introduced. In the discussion of the static question, we will zoom in and out on different aspects of the interactive relation between person and environment that characterize the relevant differences between acute and chronic pain. In the examination of the dynamic question, we will focus on the non-linear relation and mutual influence of these aspects in pain chronification. For the sake of simplicity, we will limit our approach to three domains labeled as follows: (a) phenomenal-existential, including experiential and existential aspects, (b) physiological, and (c) socio-cultural.

3 Pain and the field of affordances

In this section, we apply the previously outlined framework and methods to the static and dynamic question on pain. In doing so, we consider the related dimensions of salience, valence, mineness, and temporal horizon introduced in Sect. 2.2. Methodologically, we rely on insights gained with respect to the domains introduced in Sect. 2.4. As such, we aim to approach in an enactive framework the phenomenal-existential perspective from which individuals experience and interpret themselves and the world, the physiological processes (inside and outside the brain) which partially mediate the relation between subject and environment, and the socio-cultural roles that humans instantiate in communities.

3.1 Static question

The decisive question for present purposes is how acute and chronic pain differ when directly compared. We start with considerations of how bodily sensations in general and acute pains in particular can be modeled in terms of a subjectively perceived field of affordances. Subsequently, we focus on the peculiarities of chronic pains in contrast to acute pains.

In a default (i.e. typical or usual) situation, the subject's experience is directed towards the world while the body remains experientially transparent. The body may structure the experience of and interaction with the world but it does typically not appear as the focus of attention (Gallagher, 2005). In contrast, bodily sensations make the body itself the object of our experience. However, bodily sensations are not simply feelings of one's bodily condition. As Ratcliffe states, "even in cases where either the body or some other part of the world appears to be the sole content of an experience, that experience retains an underlying structure where body and world are inseparable—to experience one is to experience the other" (Ratcliffe, 2008, p. 1). Under optimal conditions, bodily sensations fulfill a decisive biological function. Subjects as agents tend towards an optimal grip (Bruineberg & Rietveld, 2014;

Kiverstein & Rietveld, 2015; Rietveld et al., 2019): subjects act in such a manner to reduce felt tensions emerging due to the interplay of the condition of the environment and the condition of the subject. Bodily sensations play a crucial role as the body demands attention and action to adjust an imbalance affecting a subject's well-being and proper bodily functioning (Klein, 2015). Bodily sensations thereby seem to color our experience of the world indicating vital options for action (Leder, 1990). These characteristics can be conceptualized as changes in the field of affordances.

In experiencing acute pain, we seem to experience the body, i.e. the medium of our interaction with the world, as being under threat while the field of affordances changes, primarily with respect to specific simple motor tasks. Imagine experiencing the aching pain of a fractured ankle. Putting weight on the ankle, by walking normally or pushing something away with your foot, might appear as a behavior to be avoided by any means while we might experience the possibility of putting the feet up as quite attractive. Thus, particular parts of the field of affordances shift in acute pains as some actions call out for being avoided and certain aspects of the world appear painful; while at the same time complementary actions can become more attractive and corresponding aspects of the world appear as sources of gratification. Please note that subjects who experience acute pain do not experience themselves paradigmatically as disconnected from the world, emotionally or in terms of their freedom to act. Acute pains can play an important role in making us feel alive when we experience what we are able to bear in challenging physical exercises, for example, when running a marathon or eating spicy food (Klein, 2015). Even if we do not enjoy such experiences, acute pains can be felt as close to who we are, for example, when we endure them to gain something meaningful. Further, the subject might still be open to and actively engaged with the world while typically searching for opportunities to return to an optimal grip, sometimes through trial-and-error in which affordances related to mainly simple motor tasks quickly alter in salience and valence, including attraction and aversion. In acute pains, a subject targets short-term changes in their options for action which is not typically associated with debilitating feelings of hopelessness and helplessness.

In acute pain, the body becomes an obstacle in the otherwise smooth interaction with the environment. Moreover, subjects are focused on the here and now in which prompt action is required; very specific aspects of the world are experienced as salient and immediately demanding for action. Therein lies the biological benefit of pain. Therefore, we can consider acute pain as an *altering stance*, changing the field of affordances in relatively limited ways. Under optimal conditions, as the subject dynamically interacts with the world, the felt tension of a bodily imbalance fades and the field of affordances returns to a *default stance*, similar to a stretched rubber band that returns to its original shape. Importantly, subjects do not typically experience bodily alienation, lose their sense of agency, or feel hopelessly trapped in their current situation. The outlined changes usually have no substantial or enduring impact on the person's self-image, relationships, and future planning as acute pains are typically perceived as temporally restricted, survival relevant needs that can be actively addressed. In other words, affordances do not characteristically lose their strength of mineness, although the temporal horizon is for a short period mostly oriented to the here and now.

Chronic pains are not simply persisting acute pains; chronic pain can deeply influence the interactive relation between subject and world. Chronic pain, like other chronic conditions, disturbs how people construe themselves, experience the world, and respond in relation to it (Krueger & Colombetti, 2018). Chronic pain constitutes a burden for those concerned because it limits the subject's abilities to move towards an optimal grip in the interaction with the world. As such, chronic pain reveals similar characteristics to 'existential feelings' (Ratcliffe, 2008). That is, chronic pains are bodily sensations, but they may also change the background orientation through which a subject's experiences, thoughts, and actions are structured. Chronic pain permeates all aspects of a person's life and their general attitude towards the world and sense of inhabiting such world are profoundly altered. As we shall see, the outlined characteristics of chronic pain can be usefully conceptualized as changes in the field of affordances in due consideration of phenomenal-existential, physiological, and socio-cultural aspects.

While in acute pain the dimensions of salience and valence are affected in variable ways, these changes in the field of affordances often include an activating element. In chronic pain, positively valenced possibilities to act seem to overall lose their *salience* or change their *valence* becoming negative affordances. Some possibilities for action disappear or they appear less attractive. Various actions are experienced as to be avoided as otherwise benign daily tasks become threatening. For example, stairs no longer afford what they used to but signal potential for injury, increased pain, or embarrassment. These effects concern substantial parts of the field of affordances. Chronic pain alters the field of affordances with respect to a variety of activities beyond simple motoric tasks (Stilwell & Harman, 2019). As such, patients stop doing various relevant things, leading to feelings of loneliness, isolation, and exclusion (Nichols et al., 2017). Chronic pain complicates the performance of everyday activities, such as exercising or sleeping (Breivik et al., 2006), but also the habitual fulfillment of central roles in professional, familial, cultural, and religious relations (Singh et al., 2018). By zooming in on physiological processes, we can identify substantial anatomical, neurochemical, as well as functional reorganization in chronic pain (Apkarian et al., 2011) related to motoric, cognitive, and emotional impairments (e.g., Apkarian et al., 2004; Karp et al., 2006). Patients experiencing chronic pain also show an overall altered motivational attitude, which has been related to large-scale differences in brain activity (Apkarian, 2017). Thus, although the pain might be experienced as precisely localizable within the body, patients as a whole person are in pain—feeling disengaged with the world in physical, emotional, and social terms (Kusch & Ratcliffe, 2018).

Chronic pain reveals a strong relation to changes concerning the dimension of *mineness*. In chronic pain, subjects experience themselves as alienated from their own body and their environment (Svenaesus, 2015) as the body is no longer experienced as a reliable medium through which a fluid interactive relation with the world is made possible. Chronic pain patients do not only experience their body as failing to fulfill its proper function in certain respects. Chronic pain and the felt diminishment of one's ability to function in familiar ways become a part of who affected patients are (Rolbiecki et al., 2019). The body is considered broken, weak, or old (Singh et al., 2018), and cortical alterations, such as in the primary somatosensory cortex, have been linked to a distorted image of one's own body in chronic

pain (Moseley, 2005). Furthermore, affected people often feel that their actions are determined by the pain, without having the opportunity to plan and control actions themselves (Nichols et al., 2017). Finally, in contrast to acute pain, chronic pain has a much greater propensity to ‘injure’ aspects of one’s identity, including socio-cultural roles and personal goals, which can be a source of withdrawal, sadness, or anger (Cassell, 1994). At the same time, chronic pain systematically disrupts neural dynamics revealing a negative impact on the brain’s overall processing (Baliki et al., 2008), including processes related to reward and motivation (Apkarian et al., 2011).

Chronic pain shapes the perceived field of affordances with respect to the *temporal horizon*. For those concerned, chronic pain is exhausting and frustrating (Nay & Fetherstonhaugh, 2012). Patients often hold negative thoughts about their future (Rusu & Pincus, 2017), are afraid of the future (MacNeela et al., 2015), and avoid making plans (Nichols et al., 2017). One loses trust in one’s body and its abilities (Kusch & Ratcliffe, 2018), leaving subjects with a feeling of meaninglessness and hopelessness (Lima et al., 2014). Thus, the perceived field of affordances is not necessarily restricted to the here and now; the present situation with corresponding disengagement, isolation, and alienation seems projected into the future. While acute pain provokes short-term changes in the field of affordances which soon returns to default, the changes related to chronic pain spread to many areas of life and affect the person’s self-perception in a profound and persisting manner. These alterations are commonly related to the feeling of being hopelessly trapped in a world of threat, limitation, and the impossibility to meaningfully engage with the world. This might, among others, account for the high co-morbidity of chronic pain and depression (Ohayon & Schatzberg, 2010).⁸

In terms of the previous analogy, the rubber band is stretched for so long that the structure cannot return to a default stance: pain becomes a deep-rooted part of the person’s history, present, and future. Therefore, in contrast to acute pain where the subject’s interactive relation to the world is temporarily altered, chronic pain must be considered a *permeating stance*. That is, chronic pain permeates all aspects of life reflected in differences across the phenomenal-existential, physiological, and socio-cultural domain. As outlined above, chronic pain profoundly transforms the way in which subjects experience the interactive relation between themselves and the environment to be conceptualized along the dimensions of salience, valence, mineness, and temporal horizon (for an illustration see Fig. 1).⁹

⁸ Chronic pain reveals strong similarities in the alteration of the field of affordances to psychopathologies such as depression (de Haan et al., 2013; Krueger & Colombetti, 2018) which is also associated with bodily alienation (Fuchs, 2005), a diminished sense of agency, as well as feelings of loss and impossibility (Fabry, 2020). A detailed empirically informed comparison of chronic pain and depression is clearly needed. Unfortunately, such analysis would exceed the scope of this paper.

⁹ Please note that there are patients whose daily life remains mainly unaffected by chronic pain, though these cases are more rare (Vlaeyen & Crombez, 2020). The permeating stance just outlined does not characterize the interactive relation of all chronic pain patients to their environment. At the same time, there might exist rare cases in which acute pain patients experience permeating changes that characterize chronic pain. For example, imagine an athlete who experiences the acute pain of a serious injury as profoundly altering their interactive relation to the world as it effects their future, self-image, social relationships, and the like. Both cases show that time itself is not the decisive factor, although the permeating stance usually develops over a longer period as more and more aspects of an individual’s life are affected by the interrupting and interfering character of pain (Vlaeyen et al., 2016) (see also Sect. 3.2).

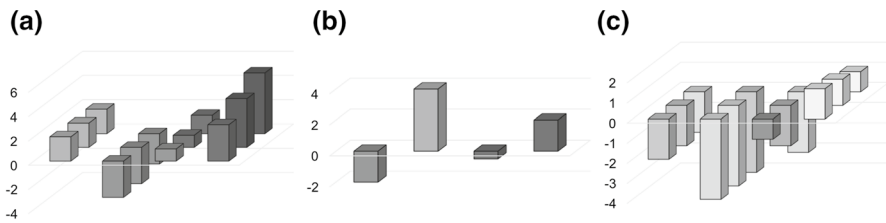


Fig. 1 Pain and the Field of Affordances (Static): **a** default stance, **b** altering pain stance (acute pain), and **c** permeating pain stance (chronic pain) Along the x-axis there are different types of affordances perceived by a single individual, ranging (left to right in each diagram) from simple motor to more cognitively demanding, emotionally laden, and socially complex affordances. This is not necessarily a distinction between different action possibilities, but between different ways of interpreting them (see also Dings, 2020). The y-axis models salience and valence. Positive values express attractiveness and negative values aversion in relation to different magnitudes of salience. (The numbers along the y-axis only serve to illustrate the difference between salience in positive and negative valence, without assuming that the corresponding properties are strictly quantifiable.) The z-axis is a timeline indicating perceived changes in the near or distant future. If no varying values are given along this axis, as depicted in (b), this expresses a strong focus on the here and now. The shade indicates different strengths of mineness. In the transition from darker to brighter colors, the loss of mineness is indicated. This figure is inspired by de Haan et al. 2013, Fig. 1. Please note that these diagrams reflect generalities in the changing fields of affordances based on trends in the literature; we recognize that each individual's field of affordances will be different and dynamically change over time

3.2 Dynamic question

In the following, we will consider the dynamic changes along the four core dimensions of the field of affordances and highlight the non-linear relation between involved processes of the phenomenal-existential, physiological, and socio-cultural domains. As we shall see, with regard to the dynamic question, the actual execution or omission of actions corresponding to perceived affordances becomes more relevant as they appear to play a central role in the dynamic cycle that leads to the generation and maintenance of chronic pain (for an illustration see Fig. 2).¹⁰

Footnote 9 (continued)

Still, a sharp distinction between the altering and permeating stance remains difficult, as their distinction is merely gradual and any clear demarcation arbitrary; in the same way, this is the case with respect to the purely temporal criterion.

¹⁰ There exists a difference between perceiving and actualizing affordances (Travieso et al., 2020): we perceive multiple relevant affordances in everyday life at the same time but we only take advantage of some of them. Thus, one needs to explain this 'filter' in the actualization of affordances (Stoffregen, 2003). For present purposes, it might be sufficient to acknowledge that pain shapes the field of perceived affordances and that in most cases we perform or avoid those actions that present themselves to us as particularly salient in positive or negative ways. In addition, the dimensions of mineness and temporal horizon shape in which manner affordances are perceived as related to who we are and how the salience and valence is expected to change in the future. These aspects might further influence the actualizing of perceived action possibilities. For example, it seems likely that affordances that are not only relevant but meaningful are prioritized. Further, we should keep in mind that the discussion here focuses solely on pain, but in everyday life it is of course not the only factor shaping our field of affordances whereby it may come to conflicts between different needs, concerns, interest, and preferences.

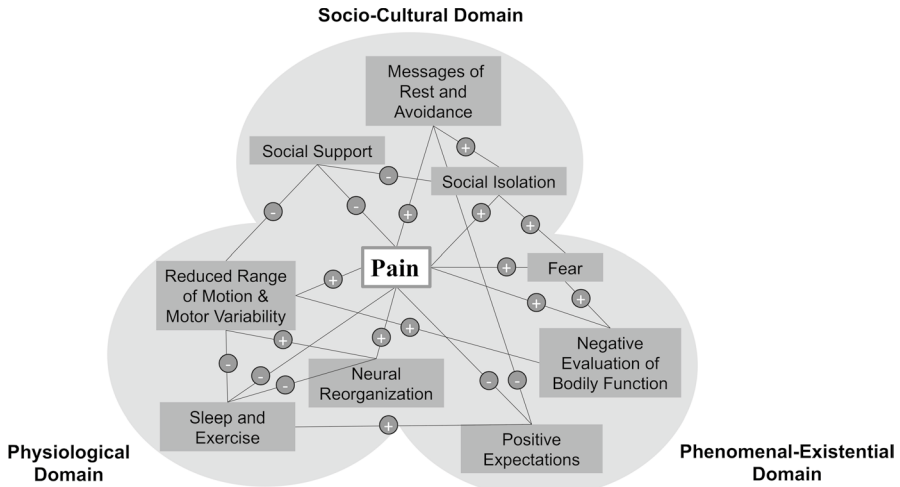


Fig. 2 Pain Chronification (Dynamic) The figure shows as an example some of the factors of the three different domains that influence and are mutually influenced by pain, while at the same time being coupled in multiple ways to each other. In the interest of simplicity, not all relevant factors and not all couplings are included in the figure. Plus and minus do not indicate whether the factors have a positive or negative effect on pain and pain patients, but rather whether the elements connected have an inhibitory or facilitatory effect on each other. For example, it is indicated that positive expectations about the future may reduce pain, while limiting both range of motion and motor variability is more likely to contribute to the chronification of pain. Further, it should be noted that the connections are mostly bi-directional. For example, fear can increase pain, but it can also be a consequence of persistence of pain. Finally, one needs to keep in mind that for the sake of simplicity this illustration does not indicate in which manner the processes of the different domains relate in terms of how the indicated processes exactly crosscut. The figure is inspired by de Haan, 2020a, Fig. 8.2 and Fig. 8.8

As outlined above, the field of affordances differs in acute and chronic pain with respect to the dimensions of *salience* and *valence*. This can be traced back to a dynamic circle of how subjects perceive themselves, their body, and the environment and correspondingly adapt to their situation. Concerned people often cope with pain by avoiding certain behaviors, for example, by restricting their range of movements. This behavior can reduce pain in the short term and, thus, is easily learned. In the long-term, continuing to engage in such behavior may paradoxically contribute to persistent pain as one continues to restrict mobility related to the performance of simple motor tasks but also meaningful activities (Van Dieën et al., 2017). Patients often refrain from performing certain actions as they fear that such movement will worsen the pain, will result in (re)injury, or out of shame over the visibility of their bodily limitations (Sündermann et al., 2020). The subject may experience their body as vulnerable and become more socially isolated: factors that in turn may promote the persistence of pain. In chronic pain, patients show impairment in safety learning, even in light of disconfirmatory evidence, as well as an excessive overgeneralization of negative emotions and avoidance behavior further restricting mobility (Meulders, 2019, 2020; Vlaeyen & Crombez, 2020). This aligns with current evidence suggesting that fear and

distress may increase the risk of the onset and persistence of pain across time (Martinez-Calderon et al., 2020). Further, there is physiological evidence linking stress to alterations in brain networks that promote sensitized states that can contribute to pain chronification (Nation et al., 2018).

One way to view this chronification of pain is as a continuous learning process in which subjects tend to negatively associate noxious stimuli but also more and more unrelated (non-noxious) stimuli, and at the same time become less able to extinct these associations (Apkarian et al., 2011; Moseley & Vlaeyen, 2015). While subjects first try out different behavioral strategies to reduce their pain and the field of affordances changes dynamically, this development escalates over time in the sense that more and more positive affordances lose salience or turn into negative affordances. This transition corresponds to ongoing plastic changes in the brain, especially in the motivational and emotional circuit of prefrontal and limbic structures, indicating that pain gradually shifts from a primarily bodily sensation related to the processing of sensory signals to a primarily affective and emotional state that persists independently and changes how the overall motivational system works (Hashmi et al., 2013; Mansour et al., 2014). This aligns with growing assumptions that chronic pain is more often related to the development of expectations of a salient and negatively valenced outcome, rather than a reflection of sensory evidence indicating threat to bodily tissues. It is possible that such negative predictions may be partly generated and reinforced through unhelpful social feed-back loops. For example, others commonly transmit messages of rest and avoidance of usual activities beyond acute phases (e.g., ‘be careful’, ‘don’t hurt yourself’, ‘stop if you feel pain’) (Buchbinder et al., 2018) and this might fuel the circle of fear, worry, stress, shame, and avoidance. This may be compounded when others blame or stigmatize the concerned patients (Slade et al., 2009). At the same time, pain may be promoted by a withdrawal from social interactions, whether professional, familial, or religious, which otherwise act as stabilizing factors that signal safety.

Chronic pain patients often feel alienated from their body and the environment and at the same time at the mercy of their situation without the possibility of leading an authentic life. Along the process of chronification, the perceived field of affordances decreases with respect to the dimension of *mineness*. As patients fail to recover based on the previously described vicious circle, they often try harder and harder to reach certain goals and thereby narrow their focus. Seemingly unattainable goals become increasingly meaningful and as subjects repeatedly fail to achieve such goals, feelings of alienation and frustration increase and a felt loss of self-identity sets in (Van Damme et al., 2008). This process might be constructed in analogy to what de Haan et al. (2013) labeled the hyper-reflexivity trap: when subjects feel the tension of losing optimal grip in pain, they aim to perform actions with high attention. This disrupts smooth interaction with the world and increases feelings of alienation and insecurity making failure not only more likely but also more salient. Subjects become aware of themselves as blocked from their goals and this is related to feelings of meaninglessness and a felt loss of control. In the course of this development, it becomes almost impossible to perform actions without high effort and attentiveness. The body becomes more and more a foreign object or obstacle alongside with negative evaluations of one’s own bodily function and appearance (e.g.

‘My body is weak’ or ‘My body is unattractive’). These evaluations further drive negative emotions and, thus, passive and aversive behavioral responses which maintain or worsen the situation (Sündermann et al., 2020). Surprisingly, the described negative attitudes towards one’s own body are often learned from and reinforced by health professionals who unintentionally counteract their own medical goal (Setchell et al., 2017).

Finally, we have seen that in chronic pain the *temporal horizon* of patients is restricted in the sense that subjects are unable to perceive attractive future affordances and are often left with a feeling of hopelessness. Based on the previously described learning circle, subjects can begin to predict pain in relation to various simple and complex behaviors that are often harmless, and this expectation can enforce the actual experience of pain (Hechler et al., 2016). Like a self-fulfilling prophecy, subjects experience pain and perceive the world as closed off because they expect to experience pain and to find the world as a hostile place in the future. It does not come as a surprise that people who tend to be pessimistic and fearful as well as those who have difficulties setting self-related meaningful goals are more vulnerable (Naylor et al., 2017). Furthermore, expectations can be significantly enforced by media, relatives, colleagues, or healthcare practitioners given how they interact with those concerned (Lin et al., 2013; Rossetini et al., 2018; Stilwell & Harman, 2017). Hereby, it is important to note that convictions and preconceptions within a community can influence a subject’s tendency to search for help but also the support offered by others, including professionals (Darlow, 2016; Henschke et al. 2016; Peacock & Patel, 2008) who constitute important elements in order to break the circle of expecting and experiencing pain.

The chronification of pain and the manner in which it alters how subjects are able to experience and engage with the world can be usefully constructed in terms of the dynamic changes in the field of perceived affordances along the dimensions of salience, valence, mineness, and temporal horizon. These dimensions differ in that the respective values can in principle be manipulated independently. An affordance of the same valence can change in salience and vice versa; an affordance of the same salience and valence can lose or gain in strength of mineness; and the temporal horizon can be narrowed or broadened, irrespective of changes in salience, valence, or mineness. However, as previously indicated, the dimensions of salience, valence, mineness, and temporal horizon are interrelated in the process of pain chronification. The vicious circle along which more and more positive affordances lose salience and the world appears more and more threatening promotes a loss of mineness. Subjects become more aware of the body as failing to fulfill its familiar function and as restricted in their opportunities to meaningfully engage with the world. Resulting feelings of bodily alienation, loss of agency, and personal dissociation may foster tendencies to project currently experienced affordances along the temporal horizon. In turn, this can lead to changes in the perceived salience and valence of affordances as subjects tend to experience merely the possibilities to act, or their absence, that they expect in the first place.

It is important to highlight that the mentioned interrelation between the dimensions extends over the dynamic bi-directional interactions between the considered domains. Given our research subject and interest, the focus may seem to be

primarily on the phenomenal-existential domain, i.e. the changes in world- and self-perception related to the dimensions respectively considered. However, as indicated before, the conceptualization of pain in terms of a field of affordances is supposed to highlight the feedback-loops between pain, aversive behavior, negative affections, changed bodily perception, and pessimistic predictions across *all* domains. This is of utmost importance for at least two reasons.

First, in enactive terms, the chronification of pain can be conceptualized as a way of engaging with the world that transforms the relation between a person and their environment in a profound manner. This is not to say that the transition to chronicity is somehow the individual's fault. Chronic pain is not simply a condition of the individual and its phenomenal-existential stance towards the world. In the same way as we might claim that the subject is insufficiently attuned to the situation, we might consider the environment as being insufficiently attuned to the subject or body and brain being disturbed in their functional organization and synchronization. Chronic pain does not emerge *only* because of a subject's negative expectations to reach meaningful goals, *or* because of a disruption of brain circuits, *or* because of unhelpful social feedback. We lose significant knowledge on the subject matter in constructing chronic pain only as a psychological, biological, or socio-cultural phenomenon: the chronification of pain is a process that relies on the dynamical coupling of processes across all domains. Second, we need to acknowledge that the initiating factors of pain may not be the same as the maintaining factors and the effectiveness of a specific treatment cannot simply be reverse engineered to conclude what caused the pain. When taking an enactive perspective, 'originary causes' are rare (de Haan, 2020a) as there is a multitude of mutually influencing processes and feedback loops between cross-cutting domains. We consider it to be a particular advantage of the enactive in contrast to the biopsychosocial framework, that it may account for the complex dynamic interaction across more local or global processes (see also Sect. 4.1).

As an illustrative example for the dynamic interaction between the domains, we may consider the positive or negative contextual effects on pain, often referred to as placebo or nocebo effects respectively that may alter one's world and self perception. Reflectively recognized or not, socio-cultural signals, such as words, interactions, and rituals, can promote safety, open up attractive action possibilities in the field of affordances, and reduce pain; or they can indicate a potential threat, color the field of affordances in terms of limitation and avoidance, and increase pain (Rossetini et al., 2018). This can lead to a cycle of negative expectations, hypervigilance, frustration, and existential concerns, which biases an individual towards an altered field of affordances and negative contextual effects. Concerned subjects might withdraw more and more while this social isolation in turn prevents any positive effects of safety signaling in socio-cultural contexts. Further, various physiological factors shape the direction and magnitude of placebo or nocebo effects (Rossetini et al., 2020). There is evidence that this involves various endocrine systems and brain networks that partly determine the effects of socio-cultural factors while being in turn continuously shaped by individual experiences and learning processes. In the next section we outline how clinicians may be able to start to navigate these complexities and dynamics in pain management by working within an enactive framework.

4 Clinical application

In this section, we outline how the previous considerations can be clinically applied. In Sect. 4.1, we focus on the general characteristics and advantages of an enactive approach to pain management. In Sect. 4.2, we focus on how our framework may guide clinical practice in reference to the four dimensions of the field of affordances.

4.1 An enactive approach to pain treatment and management

The way pain is conceptualized (by both the clinician and patient) informs the type of treatment that is considered worth pursuing. Often reductionist approaches are taken where the clinician looks for the underlying ‘root cause’ of pain and ways to ‘fix it’. Although this approach can be helpful in many scenarios, much of chronic pain is ‘non-specific’ in that there is no clear pathology to pinpoint and treat. Many have advocated for multi-pronged approaches that move beyond a focus on bodily structure and function, but a theoretically-driven framework that actually integrates various aspects and methods is still missing. As indicated in Sect. 2.4, an enactive framework complements and builds on already established approaches such as the biopsychosocial model. We hope to provide with the outlined framework a theoretical foundation that brings together a variety of different therapeutic approaches, makes sense of them in their dynamic integration, and encourages future cooperation across research domains.

In line with our enactive approach, the central goal of treatment is not to find and treat an underlying ‘cause’; instead, the goal is to help patients to better attune to their environments while equally considering all domains and their dynamic interactions. In other words, the central goal of treatment is to guide patients so that they can perceive possibilities for (meaningful) interactions with the world where the body is no longer the intruding object of attention and the source of alienation or isolation. In many ways, the concept of optimizing patients’ fields of affordances aligns with the intuitive functional approach that many clinicians already take. The enactive approach with a focus on affordances is a heuristic that can support these approaches by offering new ways to think about pain and treatment, including an appreciation of the role of action and patients’ lived experience to better personalize care. Thus, the enactive framework adds an explicit theoretical foundation and methodological toolbox for the interdisciplinary exchange and cooperation in pain research and management. This might improve the communication with patients and the general public (de Haan, 2020a, 2020b). Further, it may help to avoid tendencies of an oversimplified, reductionist, or fragmented picture of pain which appear to prevent significant progress on the subject matter.

Enactive frameworks lend themselves particularly well to the use of body-based and movement therapies as ways to alter subjects’ experience (Fuchs & Koch, 2014; Maiese, 2018). Further, the enactive approach aligns with public health promotion: there is a need to change the culture of pain to mitigate the threatening, and often non-evidence-based, messages that patients continue to be exposed to. Along these lines, part of treatment may consist in finding an appropriate niche for the person to

flourish (de Haan, 2020a; Gallagher, 2018). This could mean changing the environmental context and guiding the patient to change their habits over time, improving the way they navigate the world. With treatment and supported self-management, a subject may learn to return to the default stance (as depicted in Fig. 1).

An enactive approach does not a priori exclude or advocate for any particular treatment; instead, it provides a framework to better understand influences and connections across domains and to guide treatment decisions (de Haan, 2020a). When using an enactive framework with a focus on affordances, the clinician is prompted to equally consider the patient, their physical and socio-cultural environment, and the interaction between the two mediated by the acting body. Therefore, a focus on affordances lends itself to a holistic approach to treatment (Gallagher, 2018). There is space for more local interventions (e.g. anti-inflammatory drugs or opioids) and there is also fertile opportunity for more global interventions addressing an individual's interactive perspective on the environment (e.g. cognitive-behavioral therapy). Moreover, the enactive framework motivates interventions concerning the social and cultural environment in which chronic pain develops (e.g. by promoting supportive communication in health care).

With chronic primary musculoskeletal pain, there is growing evidence that local interventions may have less of a role in safely reducing pain and disability, as reflected in clinical practice guidelines around the world (Foster et al., 2018; Lin et al., 2019). Therefore, using rather global interventions is increasingly advocated. That said, it is vital to emphasize that the enactive approach still appreciates the importance of zooming in and to consider the potential influence of local processes (e.g. identifying important pathology such as a tumour or investigating processes of neural reorganization in chronification). In fact, the particular benefit of the enactive framework is that it provides an integrative framework that highlights the dynamic reciprocal interaction between processes of the physiological, phenomenal-existential, and socio-cultural domains. A benefit of this perspective is an appreciation that there are many routes to change that can bi-directionally influence each other. In line with this approach, multifactorial and multidisciplinary approaches that intervene at different points in the pain chronification feedback loops and make use of mutually reinforcing effects can achieve better therapeutic success (Kamper et al. 2014) (see also Sect. 4.2).

As noted by Gallagher (2020), looking at the whole complex dynamic relation between a person and their environment may be deemed by clinicians to be quite challenging. However, this should be rather understood as opening up possibilities for team-based approaches that garner expertise related to all three domains. The basis for this can only be a better understanding of the dynamic relation between the processes of all the different domains (as indicated in Sect. 3.2 and visualized in Fig. 2). In particular, the enactive framework emphasizes the need for the clinician to be flexible and to develop individualized care not only across patients, but within patients over time. For example, for some people regulating sleep patterns by maintaining certain routines and/or with the help of medication may have a stronger positive effect on the experience of oneself and one's body; while for others, better effects may be achieved by reducing social anxiety, for example, through cognitive-behavioral therapy and/or the education of the social and medical environment.

Further, inter- and intraindividual differences in the reinforcing influence that processes of different domains have on each other are to be assumed. To embrace and navigate this complexity and uncertainty, some authors suggest using personalized network models (de Haan, 2020a; Low, 2017). These advancements engage in clinical approximations regarding the impact of the different domains and their interconnections—ultimately to lead the clinician-patient dyad towards promising treatment targets and self-management. It is important to note that this process is done *with* the patient, fully appreciating their lived experience.

Next, we discuss the four overlapping dimensions of affordances and some ways clinicians may be able to optimize affordances in ways that lead to improved patient experiences and outcomes. We see it as a crucial aspect of our framework: it enables us to systematize different possibilities for intervention in pain management in reference to the introduced field of affordances while acknowledging the dynamic interaction between the domains. As such, the outlined framework allows us to navigate the complexities and dynamics of pain. As a paradigmatic example, we focus in the following on musculoskeletal conditions, including low back pain, as they represent the most prominent disabling pain conditions globally (GBD, 2016; DALYs & HALE Collaborators, 2017).

4.2 Shaping salience, valence, mineness, and temporal horizon

The *salience* and *valence* of affordances can be shaped by a wide range of possible interventions across domains. Recently, there has been a significant shift in pain management towards a ‘positive health’ approach (Huber et al., 2016) to help prevent pain and disability (Buchbinder et al. 2018): the focus is on patients’ strengths and helping them manage their lives rather than simply focusing on weaknesses, disease, or curative treatment. The positive health concept aligns with our enactive framework as it appreciates how health is achieved through a person’s ability to adapt. With an enactive approach, clinicians can work to create a context where positively valenced actions are more salient rather than relying primarily on passive strategies. For example, clinicians can help patients avoid excessive bed rest through understanding and experiencing that movements may be painful but not damaging, and that a graded approach to re-engaging in movements can help improve function and reduce pain in the long-term. Corresponding approaches are aimed at helping patients to recognise and overcome their stuck pattern of engaging with the world that shapes the salience and valence of their affordances. In the context of common chronic musculoskeletal conditions, this might be achieved through first-line treatment (Foster et al., 2018), such as cognitive behavioral therapies involving movement-based behavioral challenges and graded exposure to avoided activities. Thereby, subjects may learn to override behavioral patterns driven by fear, shame, or stress (Van Dieën et al., 2017) and there is evidence that effective treatment can partly reverse previous neural alterations (Seminowicz et al., 2011).

Rightly identified by Buchbinder et al. (2018) and Gallagher (2018), the reconstruction of affordances in therapy is not just about the concerned patient—there is a need to reconstruct broader social attitudes and institutional practices. The goal

of treatment is not necessarily to change an individual condition, but to create an environment that allows patients to explore and exploit new attractive possibilities for action (Toro et al., 2020). One way of helping achieve contextual change is for clinicians to be careful with their words and the meanings they co-construct with patients as this can shape the salience and valence of affordances (Stilwell et al., 2020). For example, saying (as is commonly done) to a patient that they simply have musculoskeletal pain because of ‘wear and tear’ may lead to the reasonable belief that general exercise will only make things worse—so it is avoided. Yet, this is contrary to current evidence (e.g. Belavý et al., 2017; Hunter & Eckstein, 2009). At the same time, a reduction of pain and unlearning of unhelpful behavioral patterns can be promoted by a range of guideline-recommended pharmacological and non-pharmacological treatments (Lin et al., 2019).

Interventions for painful conditions aimed at improving internal locus of control and self-efficacy are well-supported by evidence and are linked to *mineness* as they can restore a sense of agency, control, and familiarity with the body. This includes education and advice regarding remaining active even when experiencing acute pain and engaging in various forms of regular, meaningful activities when experiencing chronic pain (Foster et al., 2018; Lin et al., 2019). These interventions span all three domains and the reason for some of their success appears to be related to *mineness*; they can help restore, maintain, or prevent loss of fluid interaction with the world, whether that be picking up items at a grocery store or the ability to get up out of a chair. With practice, functional activities become smoother and attention is directed outwards to the environment rather than one’s body. Patients can learn that they are capable of completing various movement tasks, which can increase their self-efficacy (Bandura, 1997) which is associated with lower levels of pain and disability, and better physical functioning (Martinez-Calderon et al., 2018). In addition to exercise, other guideline-endorsed movement-based treatment, such as manual therapies (Foster et al., 2018), may help restore *mineness* by helping patients move with greater ease and confidence. At the same time, psychotherapeutic approaches can help patients to restore their personhood and re-engage with affordances that were lost during the process of chronification. Getting patients back to work, sport, and other valued activities can help restore a sense of who they are in the world.

Finally, many interventions targeting global processes may shape not only the dimension of *mineness* but also the closely related dimension of *temporal horizon*, such as behavior change techniques including goal setting, prompting intention formation, and pacing (see appendix in Harman et al., 2014). In the context of pain management, a common thread across these techniques is the importance of patient-centered pain education and motivational interviewing to help guide patients to recognize possibilities for change and future action that are meaningful to them. Recently, there has been recognition that these measures may help optimize patients’ motivation and pain-related beliefs to facilitate engagement with adaptive coping strategies for their pain (Nijs et al., 2020). Ultimately, the aim is to shift patients towards improved pain-related self-efficacy, believing that they *can* successfully (re)engage in valued activities now and in the future. Self-efficacy beliefs, active coping strategies, and positive expectations are all considered ‘protective’ and have been shown to reduce the risk of the persistence of musculoskeletal pain

(Martinez-Calderon et al., 2020). A common thread across these protective factors is a temporal horizon grounded in optimism and orientation towards the engagement of activities in the future. However, it is important to note that pain can persist despite best efforts to modulate it. In these scenarios, the acceptance of pain, adaptation of new goals, and the interpretation of pain in new meaningful ways are important (Van Damme et al., 2008).

5 Conclusions

We conceptualize acute pain as an altering stance in the interactive relation between subject and world, while chronic pain can be conceptualized as a permeating stance of engagement with the environment. In line with our enactive framework, acute and chronic pain systematically differ in terms of the field of affordances when considering the core dimensions of salience, valence, mineness, and temporal horizon. The substantial alterations that characterize chronic pain emerge due to the dynamic interactions between local and global processes of cross-cutting domains. Our approach is thereby motivated by the phenomenal-existential experiences of concerned patients accessible through subjective reports as well as data on physiological processes and socio-cultural practices accessible through corresponding scientific investigations. Thus, the enactive framework allows us to systematize the properties of acute and chronic pain in static comparison and fathom the network of dynamic, interdependent, and non-linear causal relations involved in the generation and maintenance of chronic pain. Moreover, it provides a useful heuristic of how to integrate different therapeutic measures and to navigate pain management. The enactive approach motivates a holistic approach through which patients learn to (re)experience their regular invitation to act within the field of affordances, now and in the future, while the body becomes (more) transparent and the subject gains control and confidence. The presented framework may also be useful in its application to other complex health conditions that are subjectively experienced and involve changing fields of affordances.

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