

Pain as Enactive Perception: Applying Noë's Theory of Perception

Alice I. Kyburg (kyburg@uwosh.edu)

Department of Philosophy, University of Wisconsin Oshkosh
Oshkosh, WI 54901 USA

Abstract

We begin with a view defended elsewhere that pain is a representation of tissue damage that is dependent on what one is doing. We extend this view by exploring a relation between pain and action inspired by Alva Noë's theory of perception. We consider whether sensorimotor knowledge related to tissue damage plays a role in pain experience. We explore this possibility by considering various kinds of pain, including the pain of a thorn in one's foot, that of a herniated disk, and the chronic pain that sometimes follows the healing of an injury. We find that there is a large class of pain for which the phenomenal experience could easily be informed by sensorimotor knowledge in much the way Noë claims it is for vision and other forms of perception. We also find that conceiving of pain in this way inspires new understanding of phantom limb pain and chronic pain.

Keywords: pain; perception; enactive perception; action

Introduction

Philosophical accounts of pain have covered a wide variety of theories. A recent theory by Colin Klein (2007) is that pain is an imperative, the content of which defines the quality of the experience. Michael Tye (1995, 2005) conceives of pain as a nonconceptual representation of tissue damage (or disruption). I have argued that these two accounts are much closer to each other than they at first appear and that the representationist account can be expanded to incorporate the strengths of the imperative account by acknowledging the role of action in determining how tissue damage is represented. In this paper I further develop this action-based representational account of pain by incorporating insights from (Noë, 2004) on active perception. In Section Two I describe the active representational account of pain, an expanded version of Tye's representational account of pain, that explicitly incorporates the hypothesis that how pain is represented is influenced by the activities one is engaged in. In Section Three I present some aspects of Noë's action-centered account of perception that have interesting applications to pain when pain is understood as a kind of perception. In Section Four I apply these ideas to the expanded representational account of pain presented in Section Two. In Section Five I consider how this augmented active representational account of pain fares with some of the more philosophically difficult cases of pain.

Pain as "Active" Representation

I support Tye's representational account of pain, with the qualification that representations of tissue damage are dynamic and very likely to depend on the activities the subject is engaged in and the demands they place on his representational resources. To emphasize that actions influence how things are represented, I call this version of the representation account of pain the *active representational* account. The idea is that pain is, in several ways, like vision and other forms of perception: (1) there are special-purpose sensorimotor pairings that serve to reduce the subject's representational load while facilitating specific actions and (2) the total representational load dedicated to representing tissue damage is a function of the other demands on a subject's representational resources.¹ If one has stepped on a thorn the traditional representationist will say that one's foot pain is the representation of damage to one's foot by the thorn. The active representationist will agree, but will emphasize that one's foot pain may vary with the activity one is engaged in. If one is walking with a thorn in one's foot one will have a pain that facilitates such walking. In this case the particular representation of tissue damage is part of a specialized sensorimotor pairing. If the subject lies down for a nap in the woods the pain will have a different phenomenal content – it will still be a representation of a foot injury, but it will lack the content necessary for walking.

Consider the type of pain one often has when one is first injured. There is the initial "Ow!", a sudden, intense, all encompassing pain. The content of this representation includes particular information about the injury, such as its location and whether it is, for instance, a burn, a stab, a cut, or a knock with a heavy object. The greater demand on representational resources comes from the urgent need to act (sometimes, even, the instinct to act) by, for example, withdrawing one's limb from the heat source, stepping away from the poking stick, or just removing all stress from the injured limb. It is likely that the representation of tissue damage during this initial phase facilitates the carrying out of such defensive acts. Consider the initial pain of a thorn entering deeply into one's foot. One experiences the sharp piercing pain, has a sudden and powerful urge to raise one's foot and keep it up, and tries to do so. Nearly all unrelated thoughts and actions cease.

¹ See (Hayhoe & Ballard, 2005) and (Ballard et al., 1991)

Following this sudden onset of intense pain there is often a second kind of pain. This pain reveals greater range of detail regarding the injury's type, its extent, its degree, and its impact on movement and other activities. In cases where the damage is little or none the pain quickly fades to nothing. In other cases the pain transforms into something that hurts but does not overwhelm, like an ache or a throbbing sensation. As a part of this experience one carefully surveys and assesses the wound, often using vision and touch to explore it. In the case of the thorn prick, one might look at the punctured area on one's foot, caress the surface of the skin there, and press hard around its edges. In doing so, one also intensely concentrates on it. Through these activities the injury seems to come into sharper focus -- the pain reveals greater detail regarding the nature and extent of damage to the foot, along with how movement impacts it.

Usually one does not remain focused on one's wound, however, but returns to the things that we, as humans, do. One carries out these activities of living and in many cases one experiences injuries differently as a result. In these cases, pain is a representation of tissue damage, but one that is suited for the task one is engaged in. It can be a special-purpose representation, that is, a dedicated sensorimotor pairing, or it can be a less detailed representation that frees up resources needed for other purposes. For instance, after failing to pull out the thorn, one may start to walk again, taking care to not step directly on it. While walking the pain will take on new qualitative content -- it will be an ache with a quickly shifting content that depends on where on the foot one is stepping and the direction one's weight is shifting. This ache is probably a special-purpose representation that serves as a guide to help one walk or run with a foot injury. It is part of the pairing that comprises one's ability to move effectively with a foot wound. The fact that one sometimes walks with better results after several steps suggests that the representation and motor behavior pairing can be fine-tuned as one interacts more with one's environment.

An example of how pain can be a function not just of tissue damage but of the total demands on representational resources is the severely injured soldier who manages to save another injured soldier with little awareness of the extent of his own injury. In such a case he probably makes use of a representation of tissue damage that specifically facilitates his life-saving action, but leaves out the detail that would be responsible for the great pain normally experienced when one moves with such an injury.² The experience of many actresses and athletes offers another such example. They learn that they can perform well despite severe menstrual cramps or other pains they experience just prior to performance time

² (Prinz, 2005) offers alternative theory -- that such a soldier fully perceives, is even aware of, his pain, but then does not remember.

and that while fully engaged in the performance their discomfort is significantly less.³

The types of pain described above suggest that pain, understood as the representation of tissue damage, is dynamic, varying with the action or activity of the agent. Pain can be a representation that offers just enough detail to facilitate an agent's immediate action to prevent further damage to the affected tissue. Alternatively, pain can be a detailed representation of the tissue damage, formed as the subject surveys her injury. Pain can also be a less detailed representation of tissue damage, special-purpose or not, that makes available the needed representational resources for some ongoing high-priority activity.

The dependence of the representation of tissue damage on the goals and activities of the subject suggest that it is appropriate to consider pain a form of perception and not simply a low-level representation. It follows that general research on perception may add to our understanding of pain. In the next section I look at Noë's theory of perception and consider ways in which it might apply to the active representational account of pain.

Noë's View of Perception as Action

Alva Noë has developed an influential, if controversial, account of perception that puts action at its center in a way different from what is considered above. For Noë, to perceive is to act in much the same way as a blind man acts when he uses a walking stick. It is an activity, not a passive experience. If pain is a type of perception, as many philosophers and psychologists have concluded, then it follows from Noë's account that pain too must be active in this way.⁴ In this section we sketch Noë's view of perception and in Section 5 we consider how our understanding of pain might be informed by it.⁵

Noë is committed to the controversial idea sometimes found in certain subfields of artificial intelligence that the world itself serves as an extension of our representational medium. Since we know that specific actions will

³ I learned that this is a common experience among actresses from Ethel Kyburg, a former professional actress and my mother. I am by no means suggesting that menstrual cramps are "all in the head" except in the obvious sense that they are representations of bodily disruption of some kind. What I am suggesting is that many people find that by fully engaging in highly demanding activities, the qualitative content of such pains can change.

⁴ Recent perception-based accounts of pain include (Tye, 2005), (Aydede, 2005), and (Shoemaker, 2001). (Chapman, 1986) claims that the view that pain is a function of perception is the dominant view in psychology, though as of 1986 Chapman suggested that medical field had lagged behind in this understanding of pain. More recently (Carmichael, 2007) suggests that the medical field is beginning to think of pain as perception.

⁵ To the best of my knowledge Noë has not discussed pain in any of his publications on perception. I do not mean to attribute to him any position on this subject.

immediately access certain perceptual data, we do not form an internal representation of this data. There is no need.⁶ For instance, if we shoot our eyes to the left we will find visual information regarding the tomato on the table that we know is there. We have no need to internally represent the details of that tomato when such a simple motion would provide us with them.

What is required to perceive, on Noë's account, is knowledge of the relations between certain actions or movements and the perceptual data that they *would* make available. Noë calls this sensorimotor knowledge. Sensorimotor knowledge takes the form of conditionals such as, *Were I to reach out for a perceived object like so, it would feel thusly* or *Were I to move my head to the left it would have such and such an appearance of shape and color*. In looking at the tomato on a table, there may appear something with a combination of shades of red and white that fills the approximate shape of an ellipse in our field of vision. On Noë's view we do not come to see it as a red round sphere unless we have identified a relevant set of sensorimotor knowledge. That is, we only experience the tomato as a red round sphere if we understand that were we to move our head to the left, the tomato would appear this other way, less elliptical and more round, and its color would appear that other way, were we were to reach a concave hand behind it, our hand would feel a surface that fits into its own curvature like so, and so on.

According to (Noë, 2004, 2009), the fact that the world acts as an extension of our representational medium means that there is available to us, through basic actions with our eyes and body, a rich body of sensory information about the world. If we know what we need to do to access this data, i.e., if we have already identified relevant sensorimotor knowledge, then we feel as if we already have accessed it. In perceiving we actively seek particular sensory data through saccades and movements of various sorts that we can use to identify sets of relevant sensorimotor knowledge. Through this process we experience particular colors, shapes and textures. We perceive things as filling three-dimensional spaces in particular ways. We have complete perceptual experience, or, using another of Noë's expressions, we experience objects as *perceptually present*. The gappy, bouncy stream of incoming sensory data produces a stable and gap free perceptual experience because that data enables us to identify relevant sensorimotor knowledge, giving us a sense of the presence of much more data than the incoming stream that we started with.

If sensorimotor knowledge is required by the perceiver to "close the deal in perception", as Noë asserts, that is, to go from the look or sound or feel of an object as sensed from a given perspective to a complete perceptual experience, then what implications might this have for a

representational account of pain? We now consider this question.

Sensorimotor Knowledge and Pain Action

So far I have endorsed the view that pain is the representation of tissue damage, but I have emphasized that the activity the subject is engaged in can impact how this damage is represented, and, therefore, how it feels. Noë's account of perception suggests another refinement of the representational account of pain: there is a basic sensory data concerning tissue damage and there is the way the tissue damage seems once the basic data is informed by a set of sensorimotor knowledge.

But what is the sensorimotor knowledge that is taken to be relevant to our perception of tissue damage? Consider the initial "Ow!" that often draws one's attention to a new injury. If it is a painful poke then the subject knows such things as that if she withdraws the poked body part from the source of the poking then the poking pain will relent and if she moves it closer then the pain will worsen. Similarly, if she is in the process of getting a burn she understands that if she moves the affected tissue away from the heat source or the heat source away from the affected tissue then that initial, intense burning sensation will decrease or cease. A subject also acquires relevant sensorimotor facts as she assesses a wound. For instance, she might learn that whenever she presses firmly an inch or more away from where a thorn has entered her foot it does not hurt, whereas whenever she presses firmly a half an inch or closer to the thorn it hurts. Later, as the subject engages in movements that repeatedly impact the damaged tissue, the set of relevant sensorimotor knowledge continues to grow.

That we have sensorimotor knowledge related to our experience of pain seems obvious. Noë's view of perception, however, is that sensorimotor knowledge adds a significant component to a subject's perceptual *experience*. Applying this view to pain, it follows that sensorimotor knowledge "completes" pain, gives it "perceptual presence". These expressions, applied to pain, are unfortunate since it is difficult to conceive of any experience of pain as incomplete or lacking in presence. Still, awkward language aside, there is insight gleaned from considering the impact of sensorimotor knowledge on pain. In particular, such knowledge can add perspective to the experience of one's tissue damage in the way that Noë claims it adds perspective to our experience of seeing. Consider the experience of a person who walks with a thorn in her foot. There is no doubt that her experience of her injury serves to guide her walking. She is intensely aware of such facts as that if she moved this way it would feel thusly, if she moved that way it would feel this other way. Furthermore, such a pain sometimes feels like it has a three-dimensional shape, the surface area defining the space that one must move around to avoid more intense pain. While the entire

⁶ Versions of this hypothesis are expressed in (Brooks, 1991) and (Ballard et. al, 1991). It is also found in (Dennett, 1991).

story could simply be that what one does determines how one's tissue damage is represented, which in turn determines the phenomenal content of one's pain, an alternative suggested by Noë's approach is that sensorimotor knowledge adds something to pain experience beyond what is determined by the basic representation of tissue damage. That is, the sensorimotor knowledge of how the foot would feel were one to step this other way has some bearing on how the foot does feel, even without stepping that way. The three-dimensional form that one imagines moving around as one limps along does not serve merely as a heuristic for successful walking, it is the way that one's foot injury is experienced when walking.

The pains that Colin Klein (2007) describes to motivate his imperative account of pain serve as another example of how sensorimotor knowledge may indeed be impacting our phenomenal pain experiences. The pain from putting one's hand very near a fire seems inseparable from the overwhelming urge one has to withdraw the hand. Klein asserts that this burning pain is simply the very strong urge not to leave the hand near the fire. On the active representational account of my earlier work, the burning pain in the hand is the representation of damaged tissue that is most conducive to quick and immediate removal of the hand from the damaging location. The contribution of Noë's theory of perception is that one's sensorimotor knowledge of how the hand *would* feel *were* one to move it in certain ways relative to the fire impacts one's actual experience of the hand near the fire. That is, one's pain experience already engages knowledge of how certain movements would bring an end to the burning sensation. The urge to move the hand from the fire is not identical to the pain experience, as Klein asserts, nor is it the result of multiple inferences. It is an immediate outcome of combining sensorimotor knowledge with the representation of tissue damage.

The cases above illustrate the way that ordinary pains could be conceived as representations of tissue damage enhanced with sensorimotor knowledge. What this view implies, however, is that there is such a thing as pure sensory pain, that is, pain that is not informed by sensorimotor knowledge. An artist can identify the perspective-bound way a tomato appears without sensorimotor knowledge – it appears elliptical, with areas of different colors. The question to consider now is: is there a way that tissue damage seems without sensorimotor knowledge? Introspective reports of pain caused by impinged or damaged nerves suggest an answer. People with such pain universally agree that their pain is categorically different from other pains. While it is more difficult for them to bear than other pain, what puts it in a different category is not merely its degree of discomfort. Rather, the physical and mental behaviors that people normally engage in when they have pains have different results in these cases. For example, closely examining the pain in one's arm due to a herniated disk

does not reveal an area of damage of a certain shape and extent. One cannot learn to move around it. Nor can one press along one side of the wound and then move to the other side and thereby bring about a dull pain that seems to travel about the circumference of the damaged area. One might caress the painful area of the arm, pinch it, try to assess its extent and shape, but the information one gathers through this process is strikingly sparse. The pain due to an impinged or damaged nerve is disturbingly independent of deliberate movement in a way that ordinary pain is not. If ordinary pain has its phenomenal content in part due to the process of bringing to bear relevant sensorimotor knowledge, then the pain of an impinged or damaged nerve stands out as pain for which little or no relevant sensorimotor knowledge can be identified. Such pain is, in this sense, perspective-bound sensory data.

We have treated pain as a form of perception and applied some aspects of Noë's theory of perception to it. In particular we have treated pain as the representation of tissue damage created when basic sensory data is combined with sensorimotor knowledge. But, as in other forms of perception, there is a wide range of sensorimotor knowledge that could be drawn on and not all of it is necessarily brought to bear on any particular representation. Our knowledge that if we poke a red tomato hard our finger feels slimy does not normally find its way into our complete perceptual experience of the tomato on the table. Perception seems to incorporate the sensorimotor knowledge that is somehow deemed most relevant to the task one is pursuing. We could well experience pain differently depending on what we are doing, in part, because we bring to bear different sets of sensorimotor knowledge in different cases. The pain we experience from a thorn wound will feel differently when moving about on our feet than when lying down not just because we are putting pressure near the damaged areas in the one case but not in the other, but also because when we are lying down we are not calling up the sensorimotor knowledge relevant to walking. The subject's sense that her foot wound has a certain three-dimensional shape continues only so long as there is a stream of pokes, caresses, or other pressures on and around the region of the injury. It fades soon after such contacts cease because the sensorimotor knowledge responsible for the sense that her pain has a shape is no longer relevant.

This study of pain began by embracing the representational account of pain while emphasizing the dependence of the representation of tissue damage on what the subject is doing. We explored how Noë's account of perception might apply to pain and found that when it is combined with the active representational account presented at the start, the result provides a richer source of explanation for certain pain phenomena. I continue in this vein in the next section by applying this expanded active representational theory of pain to chronic pain and phantom limb pain.

Some Difficult Cases

Chronic pain (persistent pain in the absence of any identifiable tissue damage) is often cited as an example of mysterious pain. Often it takes the form of pain associated with an injury that has long since healed. The most compelling account of it compatible with a representational account of pain is that in such cases there still is vulnerable tissue, even though the injury appears completely healed. This tissue is represented as damaged or disrupted in some way, accounting for the subject's ongoing experience of pain. While this explanation may be correct, the theory considered here suggests another possibility as well: perhaps there is sensorimotor knowledge that was relevant to the sensations of tissue damage during the former injury that is inappropriately identified as still relevant. For instance, following foot surgery there will be an extended period during which particular movements will put stress on particularly vulnerable areas of the foot. The subject will acquire sensorimotor knowledge relevant to her injury such as: *If I step on the inside ball of my foot it feels that way, if I step on the outside it feels this other way, etc.* Such sensorimotor knowledge may well create a sense of a damaged region of the foot that one must move around, as discussed earlier. Normally, as the foot heals, this sensorimotor knowledge is updated. It could be that chronic pain in the foot is the experience of certain pressures on the foot processed with outdated sensorimotor knowledge.

Phantom limb pain is another example of pain that is not well understood. One's experience in these cases is of pain in a limb that no longer exists. (Tye, 2005b) proposes that phantom limb pain is the representation of tissue damage as in a location that is no longer a part of the body. The subject suffering from such pain has a representation that there is tissue damage in a certain place but there is no such thing. In this sense, the pain is illusory. I agree with this explanation as far as it goes, but more can be said. Many people who suffer from phantom limb pain have strong urges to move parts of their missing limbs in ways they feel would relieve their pain. For example, (Ramachandran, Rogers-Ramachandra, & Cobb, 1995) describe subjects suffering from phantom limb pain in an arm who feel as if the fingers in the missing hand are so tightly curled that they are painfully pressing into the palm. The subjects have a strong urge to uncurl their fingers to relieve the pain, despite the fact that they are fully aware that they have no fingers to uncurl. In other words, the subjects have a strong sense of how their pain would be were they to move in particular ways. What this suggests is that phantom limb pain is another case of a representation of tissue damage that is formed by processing outdated sensorimotor knowledge. In the case above, for instance, sensorimotor data of the following sort may well be informing the subject's experience: *If I curl the fingers tighter the sensation will be such and*

such; if I uncurl the fingers to this or that degree the sensation will be this other way.

An interesting implication of this account is that if a subject were to engage a different set of sensorimotor knowledge pertaining to his injury, the qualitative content of his pain would change. In fact, (Ramachandran, Rogers-Ramachandra, & Cobb, 1995) found that some subjects found relief when mirrors were set up to create the illusion that they could move their missing arm and fingers. This illusion sufficed to make them feel for a moment as if they were actually engaged in the act of uncurling the fist that was bringing so much pain. On a simple representational account of pain, why should the illusion of movement in the missing limb relieve pain? The expanded representational account considered here suggests an explanation: in seeming to move the missing hand, new data is brought to bear on the representation of his wound. The subject forms a new intention, to keep the fingers from returning to the painful, curled position, which calls up new sensorimotor pairings used in the past when his goal was to keep the (now missing) hand from curling. Furthermore, if only for a moment, he now engages such sensorimotor knowledge as, *If I curl my fingers tightly I will again feel this other (awful) way; If I flex my fingers I will continue to feel this (less awful) way, etc.* When the subject returns to feeling as if his fingers are curled painfully into his palm, this experience reflects the return to a representation of tightly curled fingers, informed by the earlier sensorimotor data: *If I curl the fingers tighter the sensation will be such and such; if I uncurl the fingers to this or that degree the sensation will be this other way, etc.*

(Carmichael, 2007) reports that in the medical treatment of U.S. soldiers who have lost limbs in Iraq and Afghanistan, there is a movement to immediately and thoroughly medicate with morphine and to continue this treatment for some time. The goal is to prevent the subject from forming the "habits of perception" responsible for phantom limb pain. But what are these habits of perception? Could they be the habits of employing particular sets of sensorimotor data that are no longer relevant? Noë's notion that a perceptual experience is made complete by the processing of a set of sensorimotor knowledge suggests a new area of inquiry in pain research: How is sensorimotor knowledge related to the representation of tissue damage unlearned when it no longer applies? Could one learn to bring false sensorimotor data to bear on the representation of tissue damage to make an injury more bearable? Assuming that athletes are good at acquiring new sensorimotor knowledge, are they less inclined to have chronic pain following their injuries? Could morphine and other pain treatments interfere with our ability to unlearn sensorimotor knowledge that is no longer relevant and our ability to learn new, relevant sensorimotor knowledge? How does morphine impact the employment of sensorimotor knowledge in the first place?

The above questions make clear a role for future work. In addition, in order to best defend the view presented in this paper, one needs to say more about internal pains such as stomach aches, the pain of cancer and lyme disease, and labor pains. These pains seem to be unrelated to how a subject moves. Is there a role for sensorimotor knowledge in the explanation of phenomenal experiences of these pains?

Conclusion

In this paper I have not attempted to establish as fact the applicability of Noë's theory of perception to pain, but, rather, to present a possibility that I believe merits further consideration by academics and clinicians. On the view under consideration, how tissue damage is experienced is determined not just by sensory data collected from the area of the damaged tissue, but also by the actions one is engaged in and by sensorimotor knowledge that relates these and other actions to the tissue. In thinking of pain in this way new kinds of explanations of pain phenomena become available, and with them, new possibilities for the treatment of pain and its prevention. I leave it to future work within the cognitive sciences to further develop and evaluate this account. At the same time, I hope that those in empirical and clinical fields are willing to consider the possible role of sensorimotor knowledge for pain experiences.

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