Learning about pain from others: an observational learning account

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Abstract

Although direct experience and verbal instruction are important sources in the development of pain-related beliefs and behaviors, accumulating evidence indicates that observation of others in pain may be equally as important. Taking a contemporary view on learning as a starting point, we discuss available evidence on observational learning in the context of pain, highlight its importance for both development and management of chronic pain problems, and discuss potential moderators of observational learning effects. We argue that the capacity to understand and appreciate the experience of another person is fundamental to observational learning, including use of this information to establish the association between pain and antecedent or consequent stimuli. A main objective of this paper is to stimulate research on the role of learning about pain from others. Several lines for further research, including clinical applications, are delineated.

Perspective

Based upon a contemporary view on learning, this focus article delineates how pain-related beliefs and behaviors may be learnt by observing others. It is discussed how further research on the acquisition of pain-related beliefs/behaviors might further our understanding of pain and disability.

Key words

pain, learning, observational learning, empathy, pain beliefs

Introduction

Negative beliefs and misconceptions about pain are central to many psychosocial perspectives on chronic pain and disability[8,50] and are often targeted as key mechanisms in cognitive-behavioral treatments.[42] Surprisingly, almost no research is available examining the origins of these pain-related beliefs. Although these beliefs can be learnt by direct experience with pain, they are also prevalent among pain-free individuals.[28,29] Here, we explore the position that pain-related beliefs and attitudes are acquired by observing others. We take as a starting point a contemporary view on learning and apply this to observational learning in the context of pain. Using this conceptualization, we examine how and when observational learning contributes to the development of pain-related responses and delineate directions for future research.

Observational learning: definition and procedures

Modern learning theories conceptualize learning as *changes in behavior that occur as a consequence of regularities in an individual's environment*.[19] Behavior, here, refers to any observable response, irrespective of whether it is the product of deliberate control (e.g., pressing a button, making a statement), reflexive/automatic processes (e.g., autonomic arousal, nociceptive reflexes), or neuronal activity (e.g., electric brain activity).[19] This view is consistent with the seminal work of Bandura,[4] who defined observational learning as changes in patterns of behavior that are a consequence of observing the behavior of others. Through observation of another's behavior in a particular situation, an individual acquires information about that situation and about the consequences of specific actions in that situation. For example, children who observe their parents displaying fear and avoidance reactions to back-stressing activities, such as lifting heavy objects, may adjust their appreciation of that particular situation ("back-stressing activities are dangerous") and the behavioral consequences ("avoidance of back-stressing activities reduces pain"). This information may translate into changes in attitudes and behavior immediately, e.g., acquisition of unfavourable attitudes to certain activities, or later when pain is experienced by the individual.

Two possible learning procedures must be considered in observational learning: classical conditioning and operant conditioning.[18] These conditioning procedures concern observed changes in behavior attributable to the pairing of initially neutral antecedent events and subsequent potent stimuli (classical conditioning), and the impact of associating specific behaviors with reinforcing or punitive consequences (operant conditioning). Illustrative of classical conditioning is the work of Field and colleagues on the role of observational learning in the development of childhood fears[1,2]: children viewed pictures of novel animals that were followed by pictures depicting scared faces or happy faces. As expected, children came to report being most afraid of the animals that were associated with pictures of the scared faces. Illustrative of operant conditioning is the work of Bandura examining the social context of aggression.[3] Children observed a video of an adult who violently and aggressively destroyed a large doll. Some of the children witnessed the adult being adversely sanctioned for this behavior and other children witnessed the adult being rewarded. It was observed that children who saw the adult being punished were less likely to imitate the aggression towards a similar doll, relative to those who saw the adult being rewarded, indicating that children learnt about the consequences of the modeled aggressive behavior.

Observational learning and pain

Investigations of observational learning procedures as sources of beliefs about pain and its treatment, pain-related fears and behavioral responding are limited. Seminal work demonstrating a powerful impact of models who were intolerant or tolerant of pain was undertaken by Craig and colleagues several decades ago (for overviews, see Craig[13]; Hermann[38]). Research participants came to match tolerant and intolerant models in both self-report[17] and nonverbal behavior[68], although the latter was not as subject to immediate social influence. The social models also had an impact upon autonomic activity and psychophysical measures of sensory processing of painful events[15], indicating that observational learning influences both observable expression of pain as well as the subjective experience.

Few experiments have subsequently been undertaken. In an experimental study,[25] children observing their mothers' reactions during painful exposure of the hand in cold water subsequently displayed lower pain thresholds when their mother had voluntarily exaggerated her pain. Furthermore, children displayed reduced facial displays of pain when the mother had voluntarily suppressed her reaction. An instructive study was provided by Olsson and colleagues,[61] who examined observational learning of pain-related fear. Participants viewed a video of a model who was exposed to signals that predicted electric shock or safety signals. The model's reactions were visible through facial and bodily display (= observation phase). Subsequently, participants volunteered in an experiment similar to the one observed (= test phase). Findings showed most pronounced skin conductance responses of observers to the stimuli signaling shock to the models in both the observation and test phase. Furthermore, fMRI analyses showed that the amygdala was involved both during learning (observation phase) and expression (test phase) of learned fear. The authors interpreted these findings as evidence for the similarity in neural processes underlying direct and observational fear learning, even though research examining both peripheral autonomic activity and brain imaging demonstrates only partial similarity with the differences having major theoretical importance[14,41,60,72]. While these and other studies provide substantial evidence of a powerful impact of observing others in pain on neurophysiological activity in observers, the broader mechanisms whereby observational learning plays a crucial role in establishing pain-related responses remain relatively uninvestigated; no systematic research is available examining cognitive and affective mechanisms (e.g., changes in beliefs about pain and attitudes toward pain) underlying the effects on behavior, including the moderators of these effects. In this paper, several lines for future research are outlined.

Modulation of observational learning

In this paper, we argue that the capacity to understand and appreciate the experience of another person, or, in other words, to "empathize" with others is fundamental to observational learning. We previously defined empathy as a sense of knowing the personal experience of the other person, which is a cognitive appreciation that is accompanied by both affective and behavioral responses.[26,27] Some empathic resonance with the model needs to be present for observational learning to take place, whether the reaction is self-oriented fear or other-oriented sympathetic fear.[27,80] A substantial functional neuroimaging literature examining cortical and subcortical reactions when pain is perceived in others indicates that primarily brain areas indicative of affective responses, rather than sensory responses, are engaged in response to another's pain.[51,73] These responses are not exclusive to humans, and have been demonstrated in non-human species as well,[49,67] explaining social learning in mammals.[11,33] In humans, basic automatic/reflexive empathic reactions observed in infants to their mothers develop with maturation and experience, resulting in the sophisticated empathic system observed in adults, in which automatic empathic processes are modulated by social learning experiences and observers' higher level executive functions.[16,26,27]

Whether covert affective and cognitive responses to another's pain translate into overt action (i.e., observable to others)[26,27] is dependent upon observed environmental regularities, observer characteristics and their interaction. Environmental and observer characteristics may impact upon the *type of information attended to and/or learnt* during observational learning, determining *if*, *how* and *when* the novel information is translated into overt behavior. When the observed event relates to the immediate needs of the observer or the observed person, the information commanding attention is likely to be translated right away into overt behavior (e.g., the observed person's reaction signals a high risk of accidental injury or a parent watching his/her child fall off a swing). On the other hand, when the type of information learnt instructs on (characteristics) of the stimulus associated with the other's behavior, the information likely will be stored in memory and not immediately translated into overt behavior (e.g., others are observed using effective pain medication or a child who sees her mother displaying pain behavior during ironing may learn that ironing is painful).

Modulation by characteristics in the environment

Diverse immediate events are expected to serve as determinants of observational learning during exposure to others in pain, including sources of information about the person in pain and setting events. Setting events include the general context (e.g., work or health care setting) and specific events leading up to, associated with, and following the evidence of a painful reaction (e.g., the presence of wounds, sources of injury). Features of the observed person in pain include behavior preceding and following the painful event, the immediate reaction to painful insult, including facial and bodily reactions to potentially painful situations, and the execution of skills that may or may not terminate or palliate the discomfort. Following from our definition of learning, observational learning effects arise from observing relationships between 2 or more environmental stimuli. For example, the combination of a model's facial expression of pain and another environmental event might inform an observer whether the situation threatens him/herself, urging the observer to avoid or even escape that situation and exercise caution thereafter (e.g., a car driving on the adjoining lane and smashing into the crash barrier) or threatens another person, encouraging the observer to assist a person at risk of pain (e.g., removing a child from a swing when another has fallen and hurt herself).[30]

Furthermore, labeling a change in behavior as a consequence of observational learning requires at least two associations to be learnt. Take as an example a child observing his/her mother evidencing a painful face when lifting a shopping bag. For the child to learn that the bag is associated with pain, first, he/she should learn that the painful facial expression of the mother relates to lifting the bag. In this illustration of vicarious classical conditioning,[5] the facial expression of pain is a biologically relevant and aversive (unconditioned) stimulus, that, if associated with bag lifting, makes the latter a (conditioned) cue signaling danger and evocative of aversive arousal. However, there is a second association that needs to be learnt in order to call the process 'observational' learning. That is, the child should also have learnt an association between the bag and painful properties of lifting the bag, which are inferred by virtue of the facial expression of the mother. This second association sets the occasion for a change in behavior that makes this form of learning "observational".

Observational learning effects are expected to be modulated by the salience and type of the environmental stimuli. Salience would include variations in expressiveness of the model; more vigorous pain or fear behaviors (e.g., reflexive escape, facial grimaces, cry) would be more likely to inform observers that the model is in need, enhancing the learning impact and increasing the probability that the observer immediately translates this knowledge into action patterns. In the context of pediatric pain, studies have indeed shown that more expressed distress by infants was associated with more parental reassurance,[79] bounce, rock and pat.[7] In children, parental reassurance, criticism and apologizing have been shown to be associated with higher expressed children's distress.[53,71] The types of pain behaviors observed in others throughout life would be expected to have a cumulative impact on the repertoire of behaviors available to observers when confronted with comparable painful situations.

Future studies should investigate which cues provided by models are particularly salient or used by observers to acquire information about painful settings. Facial displays of pain are potent forms of social communication,[78] but perhaps total body pain behaviors or displays of fear instead of pain might be even more attention-grabbing and evocative.[76] Mumme et al.[58] demonstrated that children responded more vigorously to their mother's vocal expression as compared to facial expression, possibly because acoustic properties of vocal affective expressions such as loudness and pitch may induce emotions more directly. Given that considerable human communication uses verbal channels, it is also of interest to know the differential impact of the models' verbal and non-verbal (facial or body expression, voice quality) cues. Poole and Craig[66] found that observers attached greater importance to nonverbal as compared to verbal information when judging the credibility of pain expression.

Human sensitivity to social contexts also indicates that how others in the environment react to a model's pain (behavior) might guide observational learning. As observational learning is facilitated by sharing attention,[55] studies on gaze following, an early component of shared attention, are informative. Indeed, the ability to orient attention rapidly according to the gaze of others informs observers of another's object of interest.[40] Research has shown that observer's attention is modulated by the observation of gaze direction and by inferences from this observation.[59] Furthermore, fearful facial expressions have been shown to enhance gaze-triggered attention orienting in observers.[75] In the context of pain, little research is available on this. However, others' gaze direction, along with their facial expressions, might be expected to provide crucial information about pain-related situations. For example, a father's fearful expressions when gazing at the mother's lifting of a heavy bag may signal to an observing child that lifting a heavy bag is dangerous. A striking illustration describes how infants are attuned to their mother's nonverbal emotional displays. Horton and Pillai Riddell[39] found that during routine needle injections for immunization purposes infants were more likely to attend to their mother's faces if the mother had expressed greater fear prior to the needle stick. Mothers who expressed greater fear also had infants who expressed greater facial displays of distress to the needle stick.

Features of the relationship between the observer and the model also moderate observational learning effects. Family members and other intimates are more likely to serve as models for pain-related responses than strangers, although the benefits of observational learning are not restricted to observing those close to the individual. It can be expected that observational learning will have a larger effect when there is a greater similarity between the model and the observer.[10] Observational learning effects are likely to be greater when observers belong to the same "in group" as the model (see Platow et al.[65]). As well, models' characteristics such as competence, status and power have been identified as potent moderators of observational learning effects.[4] In some situations, status and competence might be more potent than similarity. Field et al.[22] found that verbal information about stimuli may change fears in children, but only when the information was provided by adults. Many unresolved questions remain regarding the moderating effects of relationship variables in the context of pain, including the need to investigate the impact of the social distance between model and observer. Preliminary evidence from research in mice demonstrated stronger social fear learning in socially related mice (e.g., siblings or mating partners) compared to non-related mice.[43]

Finally, broad sociocultural factors influence observational learning effects, as there is evidence that the cultural context affects individuals' health-related beliefs, coping with stressful life events,[6,37] and pain behaviors.[70,81] An important factor facilitating observational learning in humans appears to be shared perspectives or worldly schemata. A relevant distinction is that between independent and interdependent self-schemata,[36,52] which impact upon how individuals cope with stressors.[48] In independent cultures (e.g., most European countries, Australia, Canada, Great Britain, United States), individuals strive to be unique and to promote personal goals. Individuals in interdependent cultures (e.g., cultures in Africa, South America, Asia and some Middle Eastern countries such as Iran and Turkey) emphasize connectedness and the social context.[52] It is reasonable to expect that observational learning effects will be much more pronounced in individuals from interdependent cultures as compared to independent cultures.

Modulation by characteristics of the observer

In the context of pain, almost no research is available examining modulation of observational learning by observer characteristics. Nevertheless, important questions can be raised concerning susceptibility of particular populations to observational learning in the context of pain. Observation of others' fearful reactions to pain-related stimuli would appear more likely to give rise to pain-related fear when observers engaged in high levels of catastrophic thinking about pain. A relevant study by Bandura and Rosenthal[5] investigated the impact of prior stress or arousal in observers upon observational learning, demonstrating that moderately aroused observers displayed the most rapid and enduring fear responses to a cue signaling pain. Those who were either minimally or markedly aroused showed the weakest observational learning effects. Habitual patterns of empathic responding also might influence observational learning effects. A recent experimental study investigated the role of dispositional empathy on the effects of observational learning of placebo analgesia. Colloca and Benedetti[12] found that observers reporting a high tendency to react with empathic concern to others in need after they had observed a model undergoing a beneficial treatment subsequently demonstrated the largest responses to a placebo intervention.

Documentation of the impact of observational learning has focused upon the relatively substantial changes instigated by observational learning, with relatively minimal attention to cognitive schemata serving as important moderator. Schemata related to pain are a product of one's family history of pain[63] which serve as a vector for intergenerational transmission of ethnocultural belief systems, as these relate to personal pain-related experiences. New information is processed in the context of how it fits the existing schema. From a learning theory perspective, it is known that existing knowledge is not easily modified. Instead, exceptions to an existing rule are learnt.[9] This is consistent with Piaget's theory[64] regarding assimilation and accommodation. Applied in the context of pain, it is reasonable to assume that available knowledge is less likely to be changed (i.e., accommodated) by a transitory, immediate experience. New knowledge (e.g., observing one's child encountering minor everyday pain) will be 'assimilated' into existing knowledge structures (e.g., my child often falls without serious consequences). In the case of limited prior knowledge, new information that is particularly salient may modify substantially existing knowledge structures (i.e., accommodation), and would be expected to have a greater impact on the observer's behavior (e.g., discovery of major new risk factors for a child). The social referencing literature is informative in demonstrating that infants are particularly prone to using another's responses to guide their own behavior when they encounter ambiguity or experience feelings of uncertainty toward a given object.[32] For children, the dialectical interplay of assimilation and accommodation may generate increasingly more complex knowledge on pain and how to cope with pain.

Furthermore, schemata may have a crucial role in observational learning as they direct our attention to schema-relevant information,[77] essentially a process of confirming pre-existing beliefs. Substantial evidence also is available demonstrating the role of selective attention in determining what is learnt and what not.[69] However, almost no research is available on the role of selective attention in learning from others. In the context of pain, selective attention for behaviors of individuals in pain might strongly direct learning. Pain commands attention, whether in self-experience or when in settings where others encounter injuries or there is acute exacerbation of pain.[30] Given the importance of others' faces in learning about the world[23] and pain in particular,[16,78] pain research should investigate the variables impacting upon selective attention to (pain) faces, and the effects of selective attention upon learning. Observational learning effects would be expected to be stronger when processing familiar others rather than strangers. Mothers allocate increased attention to their own children's faces compared to other child and adult faces.[31] Furthermore, observational learning effects may be stronger in individuals with high fear of pain because of preferential processing of threatening information. Also, risk groups for not profiting from observational learning should be identified. Given that faces do not capture selective attention in children with autism spectrum disorder,[46] those children would be expected to show less evidence for observational learning in the context of pain. Furthermore, relationship schemata (e.g., attachment),[54] which have been found to modulate attention,[20] may direct future learning about pain from others.

Finally, developmental (e.g., intellectual capabilities, infant, child, adolescent stage[34,35]) and sociodemographic characteristics, such as gender, are important. The substantial gender differences associated with pain[74] would be expected to have at least some basis in observational learning.[56] Women report more pain models who also are more frequently female and would encounter a more supportive environment in which to express pain than would male peers.[47] Gerull and Rapee[24] demonstrated that gender influenced observational learning effects: girls exposed to rubber snakes and spiders showed more avoidance behavior following the observation of negative reactions of their mothers than did boys. In the context of pain, few studies are available. Goodman and McGrath[25] did not find differences between boys and girls in displayed pain behaviors to a cold pressor task after observing their mother performing the task. In future studies, it would be worthwhile considering observer-model gender similarity. For example, it is reasonable to assume that observers might be more susceptible to observational learning from same-gendered models.

Conclusion

Some evidence is available on the importance of observational learning as a determinant of pain experience and behavior, but the field warrants further development. Anxiety research has been instructive as observational learning has been identified as an important pathway for developing anxiety disorders,[57] and as equally important as direct and instructed fear learning pathways.[62] Future studies in the context of pain should investigate the conditions under which observational learning takes place, the type of knowledge learnt during observational learning (e.g. beliefs about pain and its treatment, display rules), and when and how this knowledge is translated into overt behavior. Research also should examine whether particular types of pain-related beliefs or behaviors are more affected by learning from others, and whether particular environmental or observer characteristics moderate observational learning for some beliefs or behaviors and not for others.

A better understanding of these observational learning mechanisms is expected to have implications for the prevention and management of clinical pain. While speculative, observational learning influences appear to have a substantial impact on the acquisition and treatment of typical and atypical pain behavior.[13] Several new avenues for clinical applications appear worth exploration. Involving the entire family in therapy (e.g., children, spouse) instead of only the pain model may enhance therapy effectiveness, by making use of observational learning effects (e.g., modelling of adequate coping behavior by family members). Some evidence is available; e.g., spouse-assisted coping skills training (including joint practice in pain coping skills) in a psychosocial intervention for chronic pain has been found to be effective in enhancing self-efficacy and coping abilities of ostheoartritis patients.[44] Furthermore, as evidence is available on the “immunisation” qualities of previous exposure to non-fearful models,[21,57] the application to pain-related situations needs further study. In case of existing maladaptive pain behaviors (e.g., sustained avoidance), future studies should examine whether exposure to models who have mastered fear of pain, and have re-engaged in activities is effective in reducing pain-related fear and avoidance behaviors.[45] Finally, research should point out whether maximizing similarities among chronic pain group therapy members might enhance observational learning effects.

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