The study of empathy, a translation of the term ‘Einfühlung’, originated in 19th century Germany in the sphere of aesthetics, and was followed by studies in psychology and then neuroscience. During the past decade the links between empathy and art have started to be investigated, but now from the neuroscientific perspective, and two different approaches have emerged. Recently, the primacy of the mirror neuron system and its association with automaticity and imitative, simulated movement has been envisaged. But earlier, a number of eminent art historians had pointed to the importance of cognitive responses to art; these responses might plausibly be subserved by alternative neural networks. Focusing here mainly on pictures depicting pain and evoking empathy, both approaches are considered by summarizing the evidence that either supports the involvement of the mirror neuron system, or alternatively suggests other neural networks are likely to be implicated. The use of such pictures in experimental studies exploring the underlying neural processes, however, raises a number of concerns, and suggests caution is exercised in drawing conclusions concerning the networks that might be engaged. These various networks are discussed next, taking into account the affective and sensory components of the pain experience, before concluding that both mirror neuron and alternative neural networks are likely to be enlisted in the empathetic response to images of pain. A somewhat similar duality of spontaneous and cognitive processes may perhaps also be paralleled in the creation of such images. While noting that some have repudiated the neuroscientific approach to the subject, pictures are nevertheless shown here to represent an unusual but invaluable tool in the study of pain and empathy.

Introduction

In 1873, the German philosopher Robert Vischer introduced the term ‘Einfühlung’ in his book Über das optische Formgefühl: Ein Beitrag zu Aesthetik (On the Optical Sense of Form: A Contribution to Aesthetics), a brief treatise concerned with the psychology of aesthetics and form perception. Soon after, the underlying principles behind Einfühlung were discussed in a rather rambling fashion by the English art historian, aesthetician and novelist, Vernon Lee (pseudonym for Violet Paget): ‘the word sympathy, with-feeling—(einfühlen, “feeling into,” the Germans happily put it)—as the word sympathy is intended to suggest, this enlivening...is exercised only when our feelings enter, and are absorbed into, the form we perceive’. A few years later, in 1909, and when the subject was starting to be studied by Theodor Lipps and other psychologists, the British psychologist Edward Titchener first translated into English the term Einfühlung as ‘empathy’. The concept and studies of empathy thus originated in the realms of aesthetics and then psychology, several decades before neuroscientific studies began (for references and historical review, see Wisé, 1987).
Only fairly recently have investigations begun on the neural processes underlying empathy, and intriguingly the historical wheel has turned full circle, as it is the links between empathy and aesthetics and art that have been of renewed interest. But now, however, the subject has attracted the attention of neuroscientists, notably following Freedberg and Gallese’s paper in *Trends in Cognitive Sciences* entitled ‘Motion, Emotion and Empathy in Esthetic Experience’ (Freedberg and Gallese, 2007). The present paper aims to explore a number of issues concerning the empathetic response to much of art; focuses particularly on pictures depicting pain; and takes into account both the nature of the images themselves and the contributions of art historians to the neuroscientific discussion.

**Art and empathy: two different perspectives**

As a preface, it should be noted that a single definition of ‘empathy’ has never been agreed, and Leiberg and Anders (2006) cited nine different definitions, one of their own being ‘the ability to perceive, share, and understand others’ emotions’. In the more specific context of pain, again a number of definitions have emerged, one such definition simply comprising ‘a sense of knowing the experience of another person with cognitive, affective and behavioural components’ (Goubert et al., 2005).

When considering the links between art and empathy, Freedberg and Gallese (2007) maintained that ‘a crucial element of esthetic response consists of the activation of embodied mechanisms encompassing the simulation of actions, emotions and corporeal sensation...’. The ‘embodied mechanisms’ comprise the mirror neuron system—in humans sometimes termed the action-observation network (Shaw and Czekóová, 2013). Mirror neurons, as first described 20 years ago in macaques, comprise neurons in the ventral premotor cortex that not only fire during execution of goal-directed activity, but also vicariously during observation of the same action (for review, see Cattaneo and Rizzolatti, 2009). Subsequently mirror neurons were found in brain regions other than the premotor cortex, including the auditory cortex in songbirds, and evidence emerged for similarly vicarious activation in somatosensory and emotional systems (for review, see Keysers and Gazzola, 2009).

The discovery of this system ‘illuminates the neural underpinnings of the frequent but hitherto unexplained feeling of physical reaction, often in apparent imitation of the actions represented within a work of art or suggested by the implied movements involved in its making; mirror neurons also offer the possibility of a clearer understanding of the relationship between responses to the perception of movement within paintings, sculpture and architecture... and the emotions such works provoke’ (Freedberg and Gallese, 2007).

These authors also went further, claiming: ‘...no esthetic judgment is possible without a consideration of the role of mirroring mechanisms in the forms of simulated embodiment and empathetic engagement that follow upon visual observation’, and ‘no form of esthetic appreciation... can be fully envisaged without considering mirror systems and their role in embodied and empathetic responses...’ (Gallese and Freedberg, 2007).

Although these authors thus clearly envisaged a major role for mirror neurons in the response to art, there had also been another view that they briefly acknowledged but ‘argued against’ (Gallese, 2011). This view, which comprised ‘a fully cognitive and disembodied approach to esthetics’, had been held by several eminent 20th century art historians, notably Ernst Gombrich and others in the field such as R.G. Collingwood, for whom ‘Art came to be thought of as a matter of pure cognition’ (Freedberg and Gallese, 2007), and Nelson Goodman who, while acknowledging that he might ‘invite hot denunciation for cold over-intellectualization’, had claimed ‘in aesthetic experience the emotions function cognitively’ (Goodman, 1969).

Thus there have been two different approaches to how art might be ‘processed’ in the brain: one that implicates simulation, emotion and empathy, and the other that implicates ‘pure cognition’. A cognitive approach to art can nevertheless elicit an empathetic response, an experience perhaps revealed most strikingly on viewing abstract or other non-figurative art. These two approaches—one implicating mirror neurons, the other not—tend to be studied differently, by means of neuro-imaging and psychological techniques, respectively (see de Vignemont and Singer, 2006). Freedberg and Gallese (2007) favoured the former approach; they considered that empathetic responses to art have ‘a precise and definable material basis in the brain’, with mirror and canonical neurons playing a crucial role, and there is now extensive evidence that mirror neurons are also implicated in numerous areas beyond their original, and perhaps particular, involvement in movement (Keysers and Gazzola, 2009).

Discussed below, however, many images appear to engage the viewer empathetically without engaging mirror neurons, from which it follows that other processes must be enlisted. Whether visual and other inputs into the mirror neuron system then elicit empathy directly, or indirectly through intermediary processes, remains unknown. As discussed below, however, many images appear to engage the viewer empathetically without engaging mirror neurons, from which it follows that other processes must be enlisted. The nature of these other processes—and whether they indeed subserve the cognitive approach of the art historians—remain unknown too, but both indirect involvement of the mirror neuron system, and alternative, non-mirror neuron pathways that lead directly or indirectly to the eliciting of empathy, remain possibilities. These issues are of more than theoretical concern, nowhere more evident than in studies of pain which, in the light of pain’s entirely subjective nature, unpleasant and pervasive features, and ability to
evoke an empathetic response, attain particular importance. Thus, because teasing out these different approaches is both revealing and has practical implications, the discussion that follows mainly focuses on pictures relating to the depiction of pain.

Pictures of pain: the involvement of mirror neurons?

Images of pain have been known to trigger emotional responses for millennia. For instance, classical sculptors were extraordinarily adept at depicting pain amongst other emotions, witness famous sculptures such as the *Laocoon* or the *Flaying of Marsyas*. There is no doubt that in these sculptures we are seeing pain and suffering on an epic scale, and we can empathize with the protagonists. Another example from two centuries ago was reproduced by Freedberg and Gallese, who included in their paper a picture from Goya’s *Los Desastres de la Guerra* (The Disasters of War) with the legend ‘Embodied simulation in esthetic experience: empathy for pain’ (Freedberg and Gallese, 2007)—although the justification for this legend is assumed rather than established. And at the other end of the historical timeline, there are endless contemporary paintings, photographs and moving images depicting pain and evoking empathy, even in the medical literature; who could not be affected by the grainy image of the grimacing, suffering soldier in World War II clutching his causalgic limb (Mayfield and Devine, 1945) (Fig. 1)?

Are mirror neurons in the viewer’s brain enlisted? Remarkably, that these neurons might indeed sometimes be implicated in the empathetic responses to art in general receives support dating back at least 500 years. Leonardo da Vinci recorded that ‘An artist painted a picture that whoever saw it at once yawned, and went on doing so as long as he kept his eyes on the picture, which represented a person who was also yawning’ (Richter, 1970). This account chimes with the observation by the art historian Bernhard Berenson in respect of the Renaissance nude, whose ‘taughtnesses of muscle and those stretchings and relaxings and ripplings of skin which, translated into similar strains on our own persons, make us fully realise movement’ (Berenson, 1896). At present, however, the possibility that mirror neurons are indeed involved when such images are viewed remains conjectural rather than established.

There seems little reason to doubt that images specifically depicting pain and evoking an empathetic response might similarly engage the viewer by enlisting the mirror neuron circuitry. Indeed, according to another distinguished art historian, Aby Warburg, Renaissance artists such as Dürer conveyed expressions of pain and other emotions in their pictures by drawing on those methods devised by the classical sculptors, a method which a century ago he termed ‘Pathosformel’ (translated now as ‘emotive formula’) (Warburg, 1999). Again this is particularly likely when those images suggest movement and evoke empathy, and striking evidence once more dating from the Renaissance supports this possibility: viewers of the *Laocoon* statue ‘…can’t help but writhe and be moved to pity those statues as though they were alive’ (Doni, 1549).

At least partly underpinning ‘movement’ in pictures is the phenomenon of ‘Movement without Motion’, i.e. the perception of movement in the absence of actual motion, which long before its investigation by neuroscientists was studied by art historians, notably Rudolf Arnheim, Professor of the Psychology of Art at Harvard.

‘There is neither physical motion nor the illusion of it…We have learned to associate motion with the visual images of a running man or a waterfall. When we see an image commonly connected with motion, we supply the element of displacement where it is absent in the perceptual experience itself’ (Arnheim, 1967).

The particular engagement of the mirror neuron system associated such ‘movement’ may well result from processes variously termed imitation (Losin et al., 2009) or mimicry (Hoffman, 2010), which are automatic and preverbal (Hoffman, 2010), and which lead to simulation—‘the reenactment of perceptual motor, and introspective states acquired during experience…’, and which ‘provides a general mechanism for establishing empathy’ (Barsalou, 2008).

Pictures of pain: alternative processes mediating the empathetic response

There is evidence, however, that images depicting pain can also engage neural processes that do not involve these neurons, and, crucially, it is predominantly the artist and the
art historian who have revealed the importance of what appear to be alternative, cognitive processes.

Thus, as long ago as the late Middle Ages, religious pictures designed to produce emotional effects sometimes showed sufferers experiencing pain without the expected expression. To cite just one example discussed by the cultural historian Javier Moscoso, the *Flagellation of Saint Marina* depicted in the Spanish altarpiece in Valladolid, Spain, and dated around 1500, shows the martyr suffering extreme violence but without any hint of distress (Fig. 2). Typical of such images, ‘...nothing in their peaceful faces or their calm gestures allows us to infer any presence of harm’ (Moscoso, 2012). It is evident that the terrible pain and suffering shown in these pictures are unlikely to be mediated by cerebral processes involving mirror neurons; rather, it is learned, cognitive processes experienced within the prevailing culture that mediate the impression of suffering. Similar processes may well underlie the response to those countless images of both sacred and secular themes depicted over the centuries, which seem to suggest or allude to rather than explicitly reveal excruciating pain.

Yet, different from these images, depictions of pain, or relating to pain, need not be figurative at all. Instead they can be abstract or symbolic, but, like abstract art in general (Melcher and Bacci, 2013), can be created to evoke an empathetic response. For example, the contemporary artist Deborah Padfield, working closely with the patients themselves, represented their pain through illustration. But now ‘The resulting images do not so much depict pain as express it; they help, thereby, to objectify pain’ (Hurwitz, 2003), and several were reproduced in a photographic collection entitled *Perceptions of Pain* (Padfield, 2003). Such images, for instance one that shows fractured glass superimposed on the sufferer’s back (Fig. 3), or another—entirely disengaged from any sufferer—which features a piece of burning barbed wire (Fig. 4), cannot generate a visually mediated impression of pain through processes involving mirroring, any more than can the Renaissance altarpiece referred to above. Rather, such images suggest pain by means of metaphor. Just as patients so often talk or write about their pain by invoking analogy or metaphor (Schott, 2004), so too visual analogy implicates intellectual or cognitive processes, rather than evoking the simulated actions, postures, emotions or sensations that engage mirror neurons. And surely the most extreme forms of pictures with pain, which is suggested rather than revealed, must be cartographic: the markings, symbols and colours that patients sometimes add to body maps (Schott, 2010). Here visual pain metaphor is at its most abstract, but these pictorial adornments nevertheless remain a graphic method for communicating painful experiences and evoking empathy. In all these examples, mirror neuron involvement
can surely be excluded; whether empathy evoked through such non-mirror neuron systems might be less intense than that evoked through the mirror neuron system is unknown.

A particularly revealing anecdote illustrating the seeming lack of involvement of mirror neurons is that recently reported by Elaine Scarry, Professor of Aesthetics and the General Theory of Value at Harvard (Scarry, 2007). She described a crowd of 7-year-old school children who, visiting a museum, were asked to ‘...sit in front of the painting that has the most physical pain in it.' A number of the children sat beneath Rubens’s Prometheus Bound, and Scarry observed that the children seemed to empathize with Prometheus, whose chest is being torn open by an eagle’s beak (Fig. 5). In some way the children had associated the drama with pain, in keeping with the known ability of children to appreciate the facial signs of pain in others by the age of 5 or 6 (Deyo et al., 2004). Thus arguing against the view that 'empathy may be based on “mirror-matching” simulation of others’ state' (Avenanti et al., 2005), very different cognitive processes must be involved; what mirroring could occur in respect of a Greek demi-
god’s chest being torn open by an eagle’s beak? Recalling the examples cited in the preceding paragraph, imagination and appreciation of metaphor, but not memory, must be implicated, and Scarry’s account confirms these cognitive processes are already well-developed in even young children.

**Pictures of pain as experimental stimuli**

The majority of studies on the processes involved in empathy and the perception of art in general, but here pictures of pain in particular, have used functional MRI, and less often transcranial magnetic stimulation and other neurophysiological techniques. Apart from the mention below relating to temporal factors and mirror neuron responsiveness, these studies not only shed little light on whether mirror neuron or other systems are involved in eliciting empathy, but also raise a number of other issues.

First, pictures used as experimental visual stimuli have not been made by a creative artist. They are thus inherently different from pictures with the emotional impact aimed for by an artist and can appear out of any context and disembodied, and their selection sometimes seems arbitrary. Furthermore, just as viewing artworks compared with images from ‘everyday’ life may engage different neural networks (Cupchik et al., 2009), so the emotional impact
and empathy achieved by an artist might engage different neural networks compared with the images used in the experiments. Both the length of time during which a picture is viewed and contemplated, and the order in which its component features are scanned, may also be factors which influence the neural networks engaged and the empathetic response. Thus, in the example of Flagellation of Saint Marina, observing first the peaceful Saint’s expression, or alternatively the surrounding torturers and their weapons, might result in inconsistent if not conflicting responses.

Another issue concerns the different temporal presentations of the visual stimuli. While some studies have involved the viewing of in vivo pain-inducing procedures rather than images (Singer et al., 2004), many studies have used brief video clips (Avenanti et al., 2005; Botvinick et al., 2005; Benuzzi et al., 2008), which are sometimes ‘edited’ (Lamm et al., 2007), or still photographs (Jackson et al., 2005; Saarela et al., 2007). The different temporal presentations may be important in relation to the different responsiveness of mirror neurons: observing real actions evokes the strongest responses in the mirror neuron system compared with video images, but even observation of static images of actions evokes responses in that system (Gallese, 2011)—and responses could be even greater when viewing artists’ creations, as these tend to be viewed for far longer than those presented in experiments (Smith and Smith, 2001).

A further issue is the different nature or character of the experimental visual image itself. Some have been of images of painful events such as a soccer player breaking a leg or a rider falling from a bicycle (Osborn and Derbyshire, 2010), whereas others have used images of painful insults inflicted on a hand, a foot, or a neutral object (Avenanti et al., 2005; Jackson et al., 2005; Benuzzi et al., 2008), and yet others have depicted faces (Botvinick et al., 2005)—and expression is obviously a highly salient feature of a person in pain. Some of these studies have used professional actors or pantomime players (Lamm et al., 2007), and while there are differences between pictures of faces that show ‘deceptive’ compared with ‘genuine’ pain (Hill and Craig, 2002), this difference does not exist in pictures created by artists whose skill lies in revealing the very experience of pain. And as an aside, while the artist sometimes shows the pain sufferer to be serene and perhaps even smiling, as in the example of the Saint’s face in the Spanish altarpiece discussed above (Fig. 6), there are no functional MRI studies of pain and empathy that have used smiling faces although, counter-intuitively, smiles often accompany pain (Kunz et al., 2009).

Perhaps the most critical issue is whether the visual image necessarily provides an image of pain at all. Rather, images sometimes appear ambiguous. For instance, Fig. 7 displays the images used to elicit pain for the study of pain sensation evoked by observing injury in others (Osborn and Derbyshire, 2010), a study that is discussed further below. On viewing these images without the clarification that appeared in the accompanying text, the upper left picture could simply be seen as a finger being flicked, and the figure on the upper right a diver. It appears it is the context in which the picture appears or is presented, rather than solely the picture itself, which is sometimes crucial.

The diverse issues raised by these various studies suggest caution when drawing firm conclusions concerning the neural networks involved, and these are discussed next.

Some comments on neural networks subserving empathy on viewing pictures of pain

At least 15 brain regions seem to be enlisted in the perceptive, cognitive and affective engagement when experiencing art, and as these engage parallel neural networks that are interrelated and there is considerable feedback, it is ‘impossible to describe any meaningful sequence of events’ (Nadal, 2013). Nevertheless, there is now ‘hard evidence’ that mirror neurons are present in humans in at least five regions: the ventral and dorsal premotor cortex, supplementary motor cortex, and inferior parietal and temporal lobes, and vicarious activity can be detected in not only motor but also somatosensory and emotional cortical regions (Keysers and Gazzola, 2009). The discussion above suggests that, at least sometimes, this mirror neuron network mediates the response to pictures of pain and the empathy evoked. But what of other candidate networks that might subserve the alternative, cognitive approach envisaged by the art historians?

In the case of responses to specifically pain-related pictorial stimuli, functional MRI and transcranial magnetic stimulation studies (Avenanti et al., 2005) again demonstrate activation of many different areas of the brain, and
at least some of the differences may relate to whether the response to these pictures engages with the affective or the sensory components of the pain experience. Thus the affective component has been shown to be mediated by structures which include the anterior insula, anterior cingulate cortex, brainstem and cerebellum when viewing actual painful stimulation (Singer et al., 2004), or pictures (Jackson et al., 2005) or video clips depicting pain (Morrison et al., 2004; Botvinick et al., 2005); the sensory component is mediated by the sensorimotor structures of the pain matrix (Avenanti et al., 2005), particularly the left parietal lobe including the parietal operculum, the postcentral gyrus and adjacent parts of the posterior parietal cortex (Benuzzi et al., 2008); and when both affective and sensory components of pain are engaged—as in the unusual study of individuals themselves experiencing pain when observing images of another person in pain—the anterior midcingulate cortex, anterior insula, prefrontal cortex and S1 and S2 regions are implicated (Osborn and Derbyshire, 2010).

Hardly surprisingly, and using somewhat different terminology, Leiberg and Anders (2006) concede: ‘Disagreement subsists regarding the implementation of empathy and whether it occurs in a contagion-like fashion or depends on higher level cognitive processes’. The former—‘the tendency to automatically mimic and synchronize facial expressions, vocalizations, postures, and movements with those of another person and, consequently, to converge emotionally’ (Hatfield et al., 1994)—would indeed be consistent with involvement of the mirror neuron system. On the other hand, the higher level cognitive processes that include perspective-taking—‘integrating information from different sources when inferring the other’s mental state and inhibiting one’s own perspective if necessary’ (Leiberg and Anders, 2006)—seem to be important particularly in complex or ambiguous situations, and probably engage the temporoparietal regions, but particularly the prefrontal cortex (Hynes et al., 2006; Leiberg and Anders, 2006). Which networks are engaged may depend on the extent of affective versus sensory processing of pain, and it has been suggested that ‘The key variable is likely to be the mental attitude of the participants when thinking about the pain of others’ (Singer and Frith, 2005).

The parallel spectrum of creativity

Accepting there are numerous different neural networks that respond to ‘viewing’ works of art and which elicit empathy, so too there seem to be different processes underpinning the ‘creation’ of art, although it is acknowledged that creativity ‘can hardly be reduced to the functional properties of specific populations of neurons, mirror neurons included’ (Gallese, 2011). The influential art historian Max Friedländer claimed that

‘A work of art comes into being in two ways – either spontaneously, organic, or by deliberate effort…Strictly speaking, all art falls somewhere between these two extremes…The two ends of the scale are marked by the naive genius and the cold-blooded contriver’ (Friedländer, 1974).

This suggests a certain parallelism: just as both mirror processes and those subserving cognition may be implicated when viewing pictures depicting pain, so too there may be...
both spontaneous and more deliberate, cognitive processes involved in the creation of those pictures.

Conclusion
It is almost 150 years since Robert Vischer, when discussing aesthetics, introduced the term Einfühlung that was soon to become synonymous with the English term empathy. The philosopher could not have envisaged today's neuroscientific studies of empathy and the roles of mirror neuron and alternative networks, nor that these studies would also return to investigations of art, including depictions of pain. He would surely be intrigued, however, that art historians too have now become interested in the neural processes underpinning the empathetic response to art, as discussed in the case of the works of the 16th century Flemish master Jan Gossart (Kavalan, 2013).

The evidence provided here suggests that Freedberg and Gallese’s view, which envisaged the primacy of the mirror neuron network, is too narrow, and other networks, in particular those suberving cognition, are also likely to be implicated. In summary, ‘both’ mirror neuron and alternative networks are likely to be enlisted in the empathetic response to images of pain.

But at the same time it is only fair to record that this entire approach to the subject has been found unconvincing, if not condemnable, by some scientists (Casati and Pigocchi, 2007; Tallis, 2008, 2012) and philosophers (Sheets-Johnstone, 2012). Thus for Tallis ‘Works of art are not merely sources of stimuli that act on some bits of the brain. More than anything else, they engage us as human beings’ (Tallis, 2008). Such a dissenting opinion unfortunately does not explain how pictures might ‘engage us as human beings’, an issue addressed by neuroscientists who—as reasoned above—have found that pictures may indeed reveal important insights into cerebral processes mediating empathy. And in respect of pain, ‘Accepting the definition of pain as a subjective experience of genuine and deceptive facial displays. Pain 2002; 98: 16–21.’


References


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