EMPATHY FOR PAIN AND ITS MODULATING FACTORS

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Abstract

The present thesis deals with the concept of empathy for pain, its neurobiological underpinnings and modulations of the phenomenon. Empathy for pain is understood as the empathic response that occurs when recognising another in pain and entails at least the affective processes of actually felt pain in oneself. Cortical areas of importance for empathy for pain are the anterior insula and anterior cingulate cortex. Moreover, the phenomenon is correlated with high levels of empathy, as established by behavioural self-reports. Further, empathy for pain has been shown to be highly susceptible to modulatory factors giving rise to changes in the empathic response. Perceived fairness, perspective taking, intent and out-groups are all factors that can evoke change in the subsequent empathy for pain responses in humans. These modulatory factors provide insight into in- and out-group mechanisms. Cognitive strategies can regulate a diminished empathy for pain response, although further research is needed on how to cultivate and strengthen our ability to have empathy for another’s pain.

Keywords: empathy for pain, empathy, felt pain, modulation, cognitive neuroscience
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1. Introduction

Empathy as a concept has many branches, with each branch subsequently growing further, spreading into a broad scientific field with many interdisciplinary features. This thesis will focus on one of these branches of empathy, the field of empathy for pain. Empathy for pain has been an area of interest for researchers for nearly two decades and consists of the recognition and subsequent sharing of parts of the pain experience in another (Singer et al., 2004).

The aims of this thesis will in part be to develop an understanding of the phenomenon through a cognitive neuroscientific standpoint, meaning that the phenomenon will be discussed and explained through a neuroscientific perspective, i.e. what happens in our brains, as well as the subsequent behavioural outcomes. The second aim will then be to investigate in what ways our minds and behaviours change when situations surrounding the phenomenon arises.

The central cortical regions of interest in this thesis are the anterior insula and anterior cingulate cortex. It is commonly agreed upon that empathy for pain elicits specific brain activation patterns. It is less clear amongst researchers in the field whether the phenomenon should be classified as a type of pain or not. This, due to the properties most commonly associated with the phenomenon are the emotional, or affective qualities of pain (Singer et al., 2004).

The increased or decreased levels of empathy for pain can either aid in prosocial behaviour and cooperation, or produce detrimental effects in our everyday lives. Therefore, the field holds importance in our everyday lives. The cost of neglecting empathy for pain as a phenomenon, as well as the adverse effects a low empathy for pain response can have, may lead to the exclusion of larger populations. A lower degree of empathy for pain towards a specific group may create situations where great amounts of suffering is ignored for said out-group, i.e.
lowered empathy for pain can elicit severe biases and discriminative behaviour towards those excluded individuals (see, e.g. Forgiarini, Gallucci, & Maravita, 2011). A lack of empathy for pain can also result in not only a lack of empathy per se, but parallel processes that can occur together with the phenomenon can further lead to adverse effects. That is, reward-related areas can be evoked when perceiving unfair individuals in pain (Singer et al., 2006). There is a common understanding of the importance of behaving empathically, but the essential properties of empathy for pain remain largely overlooked in our society.

A base will be put down by firstly giving an overview of key concepts through their definitions and providing insights in relevant research. Different sensory modalities will be discussed, including that of empathy for pain in connection to how the phenomenon is related to the visual, auditory and somatosensory regions. Further, the thesis will go through various modulating factors, including fairness, intentionality, perspective taking and group relationships. These factors are of importance for empathy for pain and are also prone to augment empathy for pain and its functions. Perceiving a person – the target – and their actions as fair or unfair may change how one subsequently reacts to a situation where pain is induced in said target. Group relationships and its effects on empathy for pain will then be discussed. Lastly, there will be a discussion regarding the contents of the thesis and findings that have been presented with final concluding remarks.

Increased levels of empathy for pain are primarily correlated with higher levels of empathy as a whole (Lamm, Decety, & Singer, 2011). Although high levels of empathy for pain are positive in its function to maintain prosocial behaviour, there are situations where some argue it may not be favourable to experience this phenomenon – this being prominent in healthcare where a lower level of empathy for pain could allow for more efficient work with positive...
outcomes, i.e. saving lives (Decety, Yang, & Cheng, 2010). Low levels of empathy for pain in our everyday lives can come with a cost for those who are not shown empathy, as stated earlier in this section. Lower levels of empathy for pain, alongside biases toward individuals belonging to other groups than oneself, can be seen to lead to racial bias. Through cognitive strategies, empathy for pain can be regulated to produce unbiased responses, which is of vast importance for cooperation between groups (e.g. Sheng & Han, 2012).

1.1 Limitations

Although felt pain is an important aspect when discussing empathy for pain, it is an extensive field on its own and thus outside the scope of this thesis. Therefore, the current thesis will only include a small set of literature pertaining to felt pain. This, in order to provide a basic understanding of the concept.

2. Definition of Empathy for Pain and Related Terms

Choices regarding terminology are stated in this section due to variations currently existing within the scientific field of empathy for pain. A brief description of empathy for pain and closely related terms will be carried out in order to maintain clarity and coherence. Lastly, in this chapter, there will be a discussion regarding behavioural measuring techniques. This, due to the measures being a central point in empathy for pain research.

2.1 Felt Pain

Felt pain will be used throughout the thesis when describing any form of directly experienced pain, such as nociceptive pain. Felt pain can last from seconds to years depending both on the source of the pain as well as the functionality of the affected area (Millan, 1999).

Felt pain can occur in amputees where the affected limbs are no longer there, this phenomenon is called phantom limb pain and is an example of pain originating from faulty
functions (Kolb, Whishaw, & Campbell Teskey, 2016). A network of areas, the so-called pain matrix, is activated within our brains when being subjected to noxious stimuli. This network consists of cortical areas both associated with and activated when experiencing felt pain. The network includes the anterior cingulate cortex, insula, cerebellum, thalamus, primary and secondary somatosensory cortex and the supplementary motor area (Singer et al., 2004).

2.2 Nociceptive Pain

Nociceptive pain is categorised as one type of felt pain. Evoked by the activation of specific neurons – nociceptive neurons – that have the ability to encode information of painful stimuli. The process of nociception occurs when a painful stimulus excites and subsequently evokes a nociceptive neuron to fire, causing pain to be felt (Loeser & Treede, 2008). Pinpricks or needles are commonly used as noxious stimuli in studies aiming to measure felt pain (e.g. Contreras-Huerta, Hielscher, Sherwell, Rens, & Cunnington, 2014; Morrison, Lloyd, Di Pellegrino, & Roberts, 2004). These examples from empathy for pain literature are types of pain that usually lasts for only seconds and are classified as a type of acute nociceptive pain (Millan, 1999).

2.3 Empathy

An exact definition of empathy is difficult to make, as there is no agreed upon one-to-one definition regarding the phenomenon within the scientific field. There are, however, properties of empathy that are commonly used to conceptualise the phenomenon (Cuff, Brown, Taylor, & Howat, 2014).

Empathy is a multifaceted phenomenon, including emotional as well as cognitive functions within the concept. It in part involves having knowledge of the current emotional and cognitive states of another. That is, knowledge about both thoughts and feelings of another
individual. More specifically, Decety and Jackson (2004) propose three different processes, incorporating both cognitive and affective qualities, which subsequently form the bases of empathy. Moreover, it is again important to note that all components are parts of a whole, meaning that empathy as a concept is integrative. The sharing of emotional states in which oneself has recognised in another individual is an important process. I.e. the emotions acknowledged in another are subsequently felt in the perceiver. This process is based mainly on immediate recognition of another’s state, which is then represented in oneself. These affective, or emotional, qualities pertain to how another is feeling. Cognitive qualities within the term, on the other hand, include being able to separate oneself from others. That is, recognising oneself as a separate entity that is different from oneself in relation to others. Additionally, the ability to engage in perspective taking is also of importance when discussing the cognitive qualities of empathy (Decety & Jackson, 2004). Another important process worth mentioning is that of theory of mind, which refers to the ability of separating self from other, as well as engaging in perspective taking of the other individual (Lamm et al., 2011).

As stated, within the cognitive functions of empathy we have knowledge of the cognitive states of another, i.e. another’s current thoughts. Within the cognitive properties, there is also the ability to have knowledge regarding another’s affective states, i.e. what another person is feeling. Importantly to note is that empathy can in part be influenced by contextual as well as individual abilities. These are common modulators of empathy and refer to state and trait concepts. Thus, an empathic response may differ due to these factors (Cuff et al., 2014).

Although most agree on these properties of empathy, the underlying mechanisms for – or the emergence of the phenomenon is up for discussion, but a more in-depth analysis of this lie outside the scope of this thesis. The following two perspectives are worth a short mentioning.
One influential theory regarding empathy comes from Preston and De Waal (2002). Their theory, *the perception-action model*, has its base in the recognition of emotions in others leading to a mirroring process in oneself. The subjective experience of an emotional state will be autonomously reflected in oneself upon the recognition of an emotional state in another. This process stems from a series of connected areas in our brains, including emotion processing areas like the insula and amygdala, executive, and motor areas. Importantly, motor mirror-neurons – specific neurons that activate when engaging in as well as perceiving movement – are vital for this functioning. To briefly summarise, the theory posits that the own body’s representations of the same experience witnessed in another leads to an integration of both cortical motor and affective areas, which results in an automatic mirroring process of perceived emotions (Preston & De Waal, 2002).

De Vignemont and Singer (2006) propose that an empathic response can be modulated. Whether a response arises or not depends on surrounding contextual factors, indicating that the emergence of empathy may not be automatic. Factors like perspective taking, perceived fairness or expected outcome of a situation is likely to modulate the empathic response. Thus, these factors lead to a conscious empathic response in regard to the given situation. They propose that empathy as a phenomenon functions partly as a way to gain knowledge about others emotional states as well as giving rise to social behaviour and cooperation (De Vignemont & Singer, 2006).

According to Cuff et al., we can draw conclusions regarding empathy, based on the processes agreed upon within the scientific field. By analysing various definitions given on empathy, they conclude that many aspects are commonly occurring throughout the literature. By integrating several vital points and acknowledging that the phenomenon may emerge from different properties, a more consistent view of empathy may be established (Cuff et al., 2014).
2.4 Empathy for Pain

When experiencing empathy for pain, the affective qualities of the felt pain seen in another are represented in oneself. The sensory qualities of felt pain are not traditionally seen to be shared in the experience (Singer et al., 2004). Although the commonly held view of perceiving another in pain only encompasses these affective qualities, up to as much as a third of the population is said to be able to share sensory qualities of pain, most outstandingly in mirror-touch synaesthesia (Young, Gandevia, & Giummarra, 2017). This phenomenon will be discussed more in-depth in section 4.3 ‘Felt Pain during Empathy for Pain’.

Evoking an empathy for pain response in an individual can happen through several factors. Empathy for pain can be modulated by different processes, including but not limited to fairness, intergroup relationships and disorders (see, e.g. Contreras-Huerta et al., 2014; Fitzgibbon et al., 2012; Singer et al., 2006) all of which will be discussed more in-depth throughout chapter 5 ‘Empathy for Pain: Modulating Factors’.

Regarding the classification of empathy for pain as a form of felt pain or not, which has been a matter up for discussion within the field since its birth, an opinion article written by Zaki, Wager, Singer, Keysers, and Gazzola (2016) proposes a multidimensional approach. Through considering the extent of the overlap and similarities of the two phenomena instead of attempting to classify empathy for pain as either a form of felt pain or not, more research should be made on the relationship of sensory and affective properties of pain. Moreover, researchers should also take modulating factors into account when researching empathy for pain as the results may vary depending on these (see, e.g. Lamm, Batson, & Decety, 2007; Vistoli, Achim, Lavoie, & Jackson, 2016).
2.5 Measuring Techniques

One component of studying empathy for pain consists of brain imaging techniques, most commonly through functional magnetic resonance imaging (fMRI). Another essential component surrounds self-evaluatory empathic responses that, taken together with the fMRI scans, form a predictive correlation between self-estimated empathic response and actual cortical activity in empathy for pain areas (Lamm et al., 2011). These behavioural measures are essential in that a scan cannot in itself confirm an appropriate behavioural response. In this section, four commonly occurring behavioural measuring scales for empathy will be mentioned briefly before introducing a scale developed solely for examining empathy for pain responses. Firstly, the interpersonal reactivity index will be introduced as this scale has been widely used for empathy for pain research.

The interpersonal reactivity index, based on an article written by Davis (1983) encompasses four scales measuring empathy with a focus on personal differences within several perspectives of empathy as a whole. The four scales within the index are perspective taking, fantasy, empathic concern, and personal distress. Perspective taking refers to the ability of an individual to see things in another point of view. The fantasy scale revolves around being able to picture oneself as another, to identify with fictional characters. Empathic concern as a scale measures to what extent an individual expresses compassion towards others currently in a negative state. The last scales measure personal distress, a scale especially crucial within empathy for pain. This scale measures the tendency of feeling negative emotions, anxiety being the primary focus when seeing others in a negative state. The interpersonal reactivity index has a focus on as many perspectives of empathy as possible (Davis, 1983). Within empathy for pain research parts of the scale can be used as a behavioural measure. But, due to the scale being
formed for empathy as a whole, measuring empathy for pain with this scale could possibly be regarded as not being adequate enough to reflect the characteristics experienced. The index has been frequently used within empathy for pain research (see, e.g. Lamm et al., 2007; Singer et al., 2004; Singer et al., 2006; Vistoli et al., 2016).

*The empathy quotient* was developed by Baron-Cohen and Wheelwright (2004). The empathy quotient encompasses the affective as well as the cognitive aspects of empathy as one, with the premise that the two cannot easily be separated but rather that the aspects are fundamentally intertwined. As a measure for empathy for pain, the empathy quotient may not be sufficient due to similar reasons that were given for the interpersonal reactivity index. That is, that there is no specificity in regard to empathy in relation to pain (Baron-Cohen & Wheelwright, 2004).

*The reading the mind in the eyes* test, developed by Baron-Cohen, Wheelwright and Jolliffe (1997) measure the ability to recognise emotion in the eyes of another. Recognizing more complex emotions was more accessible through the eyes alone, rather than the whole face (Baron-Cohen et al., 1997). Although the relevance for this test in empathy for pain research is scarce, the inclusion of this in the current thesis is to provide a variety of examples of empathy-related tests.

*The emotional contagion scale* created by Doherty (1997) is comprised of 15 questions, aiming to measure emotional contagion. Emotional contagion occurs mainly through mimicry and often arises from "catching" another individual's explicit emotional state. Emotional contagion can be regarded to belong under the affective parts of empathy. This scale was suggested to be used in studies where expressions are used to manipulate mood (Doherty, 1997).
In 2015, Giummarra et al. proposed a scale with a sole focus on empathy for pain. The *empathy for pain scale* is further divided into three main subscales, namely *empathic concern*, *affective distress* and *vicarious pain*. These three perspectives were chosen as the main scales due to their interrelatedness and vital characteristics to empathy for pain itself. The empathic concern scale measures behavioural components regarding helpfulness and compassion. Affective distress is the most substantial subscale within the empathy for pain scale and measures negative behaviours including fear, discomfort and avoidance. The final subscale measures vicarious pain, which refers to the ability to derive or imagine the experience of another individual’s emotions or current state. In the empathy for pain scale, it more specifically refers to sensations derived from perceiving others, resulting in either a painful or non-painful perempt. Through two studies they established the validity of the new scales ability to appropriately measure the empathic, affective and cognitive responses to others' pain. By using the interpersonal reactivity index as a comparison, they concluded that the subscales affective distress and empathic concern both correlated with the affective as well as cognitive dimensions of the index. The vicarious pain scale correlated with personal distress. A lack of sensitivity and specification of the complex empathic responses occurring during empathy for pain has been a previous limitation when using general empathy measuring scales for empathy for pain studies. The empathy for pain scale creates a measuring utensil designed for the specific characteristics of empathy for pain, which could potentially provide further specificity in future research (Giummarra et al., 2015).

Throughout this chapter, an overview has been made on terminology that is central for empathy for pain and its underpinnings. This, as well as how to measure the phenomenon both behaviourally and neuroscientifically.
3. Neural Correlates of Empathy for Pain

Several studies using fMRI, with an aim to measure empathy for pain activations have found two cortical areas consistently active during empathy for pain. These areas are part of the pain matrix network, meaning that the network is not only activated when experiencing felt pain. The areas commonly activated when perceiving and recognising pain in others include parts of the insula and anterior cingulate cortex. A meta-analysis conducted by Lamm et al. (2011) reviewed 32 fMRI studies on empathy for pain. A consistent pattern of anterior cingulate cortex and insula activations were seen throughout the studies reviewed. Moreover, the areas were seen to be the primary areas activated in both nociceptive pain and empathy for pain (Lamm et al., 2011). Throughout this chapter, a discussion regarding the insula, anterior cingulate cortex and the two areas involvement in empathy for pain will be looked at more in-depth.

3.1 Insula

An opinion article by Singer, Critchley and Preuschoff (2009) set out to present the insular cortex involvement in empathy. The insula itself is found in between the anterior temporal lobe and the posterior frontal lobe bilaterally. The insula is further divided into the anterior and posterior parts of the insula. The insula has a role in affection as well as being involved in the mapping of various physical phenomena, with pain being one state represented. It has been suggested that the anterior insula may be responsible for the conscious perception of the areas mapped. The anterior insula activates both during felt pain in oneself and felt pain seen in others. Thus, it has been proposed that the insula involves both subjective properties about oneself and empathic properties directed towards others (Singer et al., 2009). Moreover, as previously mentioned, the insula is responsible for emotion processing (Preston & De Waal., 2002).
3.2 Anterior Cingulate Cortex

The anterior cingulate cortex is located in the medial part of the prefrontal cortex. The area partakes in an array of executive processes (Gazzaniga, Ivry, & Mangun, 2013). The area’s involvement in empathy for pain has, as mentioned previously, been widely researched and established (see, e.g. Lamm et al., 2011). Within the field of empathy for pain, the anterior cingulate cortex takes on a dual role. It has been suggested that the area is involved with the processing of both self- and other-related mechanisms in connection to pain. It is the processing of visual information of noxious stimuli in the anterior cingulate cortex that suggests a role for the area and other-related pain, which is needed in order to respond empathically to others’ pain (Morrison & Downing, 2007).

Two different forms of processing occur for seen and felt pain. Felt pain, which originates from a first-hand perspective based on the environment closely surrounding us, and seen pain partly based on our visual senses coding seen noxious stimuli. Morrison and Downing concluded that the two processes are not dependent on the other but may complement and work simultaneously, evoking overlapping activations (Morrison & Downing, 2007).

The insula and the anterior cingulate cortex can both be seen to be heavily involved in the process of empathy for pain.

4. Multisensory Perspectives

Empathy for pain can involve a multitude of sensory mechanisms in healthy individuals. A majority of studies conducted on empathy for pain uses visual stimuli to evoke the empathic response. Although this is the most common approach taken in research, empathy for pain can be induced through other means than viewing someone else in pain. This section will cover visual...
and auditory connections with empathy for pain as well as mirror-touch synaesthesia where empathy for pain can evoke a felt pain response.

4.1 Visually Induced Empathy for Pain

In this section, there will firstly be a discussion regarding two different types of variables used to research empathy for pain within the visual system, following a rundown of studies conducted on empathy for pain during the early stages of the scientific field, as well as discussing more recent research.

Lamm et al. (2011) mentioned previously in section 3 ‘Neural Correlates of Empathy for Pain’ included 32 studies, all using the visual system to evaluate and research empathy for pain. The studies which were included and analysed used videos, still images of painful stimuli, and abstract visual cues as variables in their research. Activations present during empathy for pain can be affected by the type of variables used during the studies. The meta-analysis on empathy for pain research paradigms conducted by Lamm et al. additionally reviewed two variables used, pictures or cues. This, in addition to anterior insula and anterior cingulate cortex activations, which would be expected based on prior research (see, Jackson, Meltzoff, & Decety, 2005; Singer et al., 2004) other areas activated was dependent on the type of variables used. Using images as a variable when conducting empathy for pain research presents individuals with a picture depicting painful stimuli. Cue-based variables provide participants with signals indicating the induction of painful stimuli. The difference in the variables used relates to the recruitment of either top-down or bottom-up processing. Using cue-based variables indirectly implicates an empathy for pain response. With this type of variable, an individual never actually sees anyone else experiencing felt pain. The knowledge of the cue representing felt pain in another requires top-down processing. These studies were shown to implicate prefrontal regions as well as the
temporoparietal junction. These areas are known to be responsible for executive functions, and theory of mind – as previously mentioned to be a phenomenon responsible for abilities regarding the separation of self from others and being able to take another individual's perspective. When using an image-based variable to induce an empathy for pain response, an individual directly sees the felt pain experience of another. This uses bottom-up processing and was seen to elicit somatosensory activations – which could be due to mimicry of one's own body in relation to the body viewed (Lamm et al., 2011).

An fMRI study conducted by Singer et al. (2004) had suggested that only areas relating to the affective properties of felt pain remain active during empathy for pain, and thus the two should be considered to be separate due to actual pain evoking cortical sensory areas. Through using cue-based variables in their study, the results showed activation in the anterior insula and the rostral parts of the anterior cingulate cortex during empathy for pain whilst felt pain areas have been shown to further extend to the posterior parts of the anterior insula and caudal parts of the anterior cingulate cortex. The sensory areas activated when experiencing felt pain were not activated when the participants (N=16) experienced empathy for pain. Instead, the activation that was seen in the primary somatosensory cortex and motor cortex was associated with pain the participants experienced in themselves. This suggested that whilst empathy for pain and felt pain share many common neural networks, the noxious stimuli when directly feeling pain was absent in empathy for pain (Singer et al., 2004). The lack of activation in sensory areas in the study could be due to the cue-based task used in the experiment, as further research by Lamm et al. (2011) had suggested. The conclusions drawn could arguably hold more strength as Singer was an author in both studies, as the exact methodology in the previous study was known when conducting follow up research. To conclude, these two types of variables result in slightly
differing cortical activations. Although the different forms of study use separate pathways to evoke an empathy for pain response, they share common ground in the recruitment of the visual system to process the stimuli (Lamm et al., 2011).

Three empathy for pain studies and their designs which were used during the fields early stages will be briefly mentioned, including the article previously discussed, conducted by Singer et al. (2004). All three studies used visual stimuli in slightly varied designs, to evoke similar empathic responses. Whilst the first of the three only uses the visual system alone, the preceding studies mentioned include tactile stimulations in their experiments. These three studies are included in this section partly to introduce the most common ways empathy for pain has been studied. This will then be followed by discussing more recent research studies using the visual system in their empathy for pain research.

In Jackson et al., (2005) an experiment was conducted through having participants (N=15) view images of limbs in situations predetermined to be painful. In this experiment, no actual pain was induced in participants. Instead, the aim of the study was to research how neural activity could be affected by participants determining and grading pain in others (Jackson et al., 2005). Morrison et al. (2004) however, researched the effect of having participants (N=14) receiving pain and subsequently witnessing a video of another, to the participants a stranger, receiving similar pain that had been afflicted on themselves (Morrison et al., 2004). In Singer et al., (2004) research was conducted on empathy for pain by selecting pairs of participants with amicable, loving relationships. Through indicating that a loved one would be receiving pain similar to pain already induced in themselves, they simultaneously measured cortical activity by way of fMRI (Singer et al., 2004).
Although the three studies had used slightly different designs in their experiments, all fMRI scans from the experiments revealed similar anterior insula and anterior cingulate cortex activation patterns. The increased activation of these areas occurred regardless of whether the participants had known each other, as seen in the study by Singer et al. (2004) or not, as seen in the study conducted by Morrison et al. (2004). Although there were similarities in their results, some findings did indeed differ between the studies. One notable difference pertains to significant correlations of behavioural measures in the three studies. Singer et al. (2004) found a significant correlation between the empathic concern scale of the interpersonal reactivity index and higher activity in the left anterior insula and the anterior cingulate cortex (Singer et al., 2004). No such significance could be found in the behavioural measures and activation patterns in the study by Jackson et al. (2005). It is of importance to note that a majority of studies conducted within the field of empathy for pain use the visual system, although some results may still differ largely based on surrounding design choices made for the experiments.

As the field of empathy for pain has grown, so has the body of research. Using the visual system to induce empathic responses has been widely used in newer studies. All the studies that will be discussed in section 5 “Empathy for Pain: Modulating Factors” induce empathy for pain through visual stimuli.

4.2 Auditorily Induced Empathy for Pain

A far less common way of studying empathy for pain is through our hearing. In Lang, Yu, Markl, Müller and Kotchoubey (2011) the auditory system was used to study empathy for pain. In the experiment, a set of either neutral or painful audio clips were presented to the participants (N=22). The experimental sounds used were all previously analysed and subsequently deemed as sounding painful. All of the sounds used as the painful stimuli involved
screaming. The control sounds were also analysed beforehand and deemed neutral or pleasant. The sounds included laughter, yawning and snoring. The participants were not specifically told to empathise with the sounds prior to the experiment. The behavioural measure used in the study was the interpersonal reactivity index whilst fMRI was used as the imaging technique. An analysis of the scans and behavioural data was conducted following the experiment. Activation was measured in the left insula, the secondary somatosensory cortex, the middle and superior temporal gyri, right cerebellum and thalamus. This finding is in line with visual empathy for pain studies. In contrast to the visual empathy for pain studies, deactivation was measured in the anterior cingulate cortex. This was hypothesised by Lang et al. to stem from emotional arousal occurring on a large scale, although the hypothesis was also instructed to be interpreted with some caution. The empathic concern subscale of the interpersonal reactivity index correlated with activity in left anterior insula as well as the thalamus. A negative correlation between the personal distress subscale and the middle and superior temporal gyri could also be seen (Lang et al., 2011).

4.3 Felt Pain during Empathy for Pain

The consensus of empathy for pain that has been the focal point of this thesis regards the phenomenon as being affective in nature. Although the empathic response refers to the core of empathy for pain, the possibility of a sensory response adjacent to the affective one has also been an area of research. There are reported instances where an empathy for pain response evokes not only the affective qualities of pain but also the sensory ones (see, e.g. Goller, Richards, Novak, & Ward, 2011; Osborn & Derbyshire, 2010). In mirror-touch synaesthesia, a perceived painful tactile stimulus experienced by someone else can lead to felt pain in oneself. This section
discusses the prevalence of felt pain in individuals viewing another in pain, firstly through congenital cases and following up with acquired cases.

**4.3.1 Congenital cases.** In 2010, Osborn and Derbyshire sought out to research what had previously only been personal reports of not only affective properties of empathy for pain, but also actual felt pain responses when seeing someone in pain. Due to the lack of experimental reports of felt pain responders during empathy for pain, a large sample of individuals were first chosen in order to find participants who might experience more than the usual empathy for pain response. They predicted that part of this group would experience self-reported felt pain during empathy for pain, i.e. part of this sample would feel pain when viewing someone else in pain. Through a presentation of images depicting individuals in pain, the participants were instructed to report whether the images elicited a felt pain response or not, alongside a series of various questions regarding their experience. Subsequently, a small experimental group was chosen from this larger sample and was comprised of those with the highest reported felt pain responses (N=10). An fMRI study was conducted on the experimental group as well as on controls. By presenting images and videos depicting painful stimulation and simultaneously asking participants to rate each stimulus, scans were taken in order to analyse any differences. Scans from both groups revealed common activation in both a part of the anterior cingulate cortex, more specifically in the anterior midcingulate cortex as well as in prefrontal executive regions. Importantly, consistent activations in the experimental group’s scans reveal a differing pattern from the control group. activations in the primary and secondary somatosensory cortices, along with the anterior insula were seen consistently across the experimental group. Moreover, ratings provided by the felt pain during empathy for pain participants during the initial experiment further showed a higher rating of all questions asked regarding the experience, including
unpleasantness and empathy. The differences between the two groups indicate the possibility of empathy for pain encompassing more than just the affective qualities in some individuals. Moreover, Osborn and Derbyshire conclude that this encompasses both the affective and the sensory properties of pain (Osborn & Derbyshire, 2010).

In Young et al., (2017) a sample of individuals (N=50) recognised as congenital vicarious pain responders were used against a control group to seek out the underlying causes of the phenomenon. This, by measuring increased and decreased respiratory rates, i.e. the tempo of one’s breaths, whilst viewing various video clips. The different stimuli varied in both emotional content and perceivable breathing speeds. The vicarious pain participants did not mimic the breaths in the videos. Instead, their breathing rates were slower than the breaths of the control group and of those in the videos. The slowed breaths that occurred was hypothesised by Young et al. to possibly stem from the participants anticipation of the pain, resulting in them holding in their breaths instead of engaging in mimicry. Moreover, the participants had a higher self-reported vicarious pain than the control group, along with higher degrees of both emotional distress and empathic concern as well as a higher anxiety score. Young et al. subsequently concluded that rather than an affective empathic response being the source of the felt pain response in individuals with vicarious pain, the base of the phenomenon may be linked to emotional distress, thus leading to a desire for avoidance. The study indicated that empathy might not lie at the base of this condition, as the sensory properties for pain are highlighted rather than the affective ones. This study is relatively new with little additional research. Therefore, Young et al. proposes that further research on vicarious pain responders and levels of distress will be needed (Young et al., 2017). The conclusions made in this study will be considered further within the discussion for the current thesis.
4.3.2 Acquired cases. The cases of felt pain occurring whilst witnessing others in pain that will be discussed in this section are in regard to cases of acquired mirror-touch synaesthesia emerging after amputation. The frequency of acquired mirror-touch synaesthesia was investigated in a study conducted by Goller et al. (2011). The participants in the study (N=28) was a group of amputees along with a control group. They were instructed to rate an extensive array of video clips and images based on whether watching the stimuli induced a tactile sensation. The presented visual clips included various objects exposed to different stimuli. The clips included human limbs, inanimate objects and fake limbs being subjected to various stimuli, ranging from low to high pain. In order to investigate the occurrence of felt pain during the presentation of the clips, the participants were simultaneously asked to rate whether they experienced any tactile feeling whilst watching the clips. During the occurrences of sensation, more specific descriptions regarding pain, intensity and the location of the tactile sensation were requested from the participants. Additionally, all participants filled in the empathy quotient as a behavioural measure to be compared with the responses from the videos. The most frequent responses across all participants were those in relation to clips depicting a high pain intensity. Moreover, the responses involving real-life limbs were significantly higher than for any other condition. The results from the study also indicated a difference within the experimental group. Part of the amputees in this group reported somatotopic sensations, i.e. tactile sensations were only felt in the same parts of their own body as had been presented in the clips. Interestingly, the remaining amputees in the experimental group reported more instances of tactile sensation, and all evoked sensations were reported to occur on their phantom limbs. According to Goller et al., this highlights an important difference within the population in need of further study. A significant correlation was found between those with a higher reported so-called emotional reactivity and a
more frequent non-somatotopic response. I.e. a significant correlation between those with an increased sharing of emotions and those who reported all sensation to occur on the phantom limb. Importantly, an aspect to take note of in this study regards to it consisting entirely of behavioural measures in the form of self-reports and questionnaires. Thus, all conclusions drawn from the study relies on the subjective responses given by the participants (Goller et al., 2011).

Fitzgibbon et al. (2012) conducted a study using transcranial magnetic stimulation (TMS) which is a non-invasive procedure where the excitability of neurons can be altered. The study included participants who had undergone amputation and additionally lived with phantom limb pain, both with and without acquired pain synaesthesia (N=28) along with a control group. The participants viewed video clips of either a painful or non-painful stimulation of either an inanimate object or a hand. After video offset, repeated single-pulse TMS was applied to the left motor cortex either one second, or three seconds after the video had started. The separate conditions made it possible for Fitzgibbon et al. to begin applying TMS onto participants both when the stimulation was approaching the object in the videos or reaching their target in others. A total of 96 pulses of TMS was applied to each participant throughout the conditions. They predicted that viewing a painful stimulus reaching its target would elicit the strongest response. Moreover, it was expected that participants with acquired pain synaesthesia would from the experiment produce the strongest amplitudes of neuronal excitability, i.e. the strongest response. All high-pain conditions subsequently resulted in higher responses across the participants. Moreover, the acquired pain synesthete group responded with higher amplitudes to the painful video clip during the TMS condition wherein the object had reached its target (Fitzgibbon et al., 2012).
Although various behavioural measures, amongst them the empathy quotient and interpersonal reactivity index were used in this study, the only significant differences found were on a depression scale where phantom limb participants had scored higher than controls. A near-significant result highlighted by Fitzgibbon et al. relates to the participants with acquired pain synaesthesia and emotional reactivity in connection to the painful stimuli presented in the videos. Although the results did not quite come out as significant, it was elevated for this group (Fitzgibbon et al., 2012). Emotional reactivity was a significant factor in the study conducted by Goller et al. mentioned previously and thus may indicate an importance of emotional sharing within the phenomenon of felt pain during empathy for pain (Goller et al., 2011).

This study provides insight into the changes in neuronal activity patterns for individuals with acquired pain synaesthesia. However, for the purpose of the current study, Fitzgibbon et al. do not include the anterior cingulate cortex or anterior insula, which are responsible for the affective properties of pain into consideration. It is worth including this article as it establishes a difference in the pain processing of particular individuals. Moreover, limitations in this study were presented in relation to the small participant sample sizes and may have had an effect on the results (Fitzgibbon et al., 2012).

Throughout this chapter, empathy for pain has been explored through different sensory modalities. What can be seen is that the phenomenon is integrated and can be induced not only by viewing another in pain, but also by hearing painful screaming (e.g. Lang et al., 2011; Singer et al., 2004). A part of the population has somatosensory activations, either congenital or acquired through an injury, leading to tactile sensations from the viewing of another’s pain (e.g. Fitzgibbon et al., 2012; Osborn & Derbyshire, 2010).
5. Empathy for Pain: Modulating Factors

Empathy for pain as a phenomenon is prone to modulation. I.e. whether an empathy for pain response will occur or not depends largely on the circumstances surrounding the individual experiencing the pain, alongside with contextual insights provided to the empathiser. In this chapter, four modulating factors will be discussed, namely, fairness, intentionality, perspective taking and group relationships. All studies in this chapter use visually induced empathy for pain in their experiments, alongside other measuring techniques.

5.1 Fairness

A well-known example of modulation within the field of empathy for pain comes from Singer et al. (2006). The aim of their study was to review changes in empathic responses when the perceived fairness of another was the subject of modulation. Two experimental groups (N=32) were used in the study, a male and a female group, to review possible gender differences. The participants engaged in an economic game along with two actors, one who engaged in the game in a fair manner whilst the other had been told to adopt an unfair playing strategy. The game chosen for the study was a slightly revised version of the prisoner's dilemma. In this version of the strategy game, the participants belonging to the experimental groups had a set amount of money from offset. The participants were then given a choice to either pass on or keep that money for themselves. In relation to the participants initial choice, the actors could then either return a high or low amount of money, depending on whether they were assigned as a fair or unfair player. From this game Singer et al. predicted that the participants in the experimental groups would view the actors as either fair or unfair. The participants were instructed to rate their perceived fairness of the actors along with likeability, agreeableness and attractiveness. The results of the ratings were as expected across both experimental groups, meaning that the
participants rated the fair players differently and more favourably to the unfair players. Moreover, they predicted activations in the orbitofrontal cortex and nucleus accumbens, areas related to reward-processing, when viewing the unfair players receiving pain. This, because cooperation is favoured in groups, further activating a reward system when uncooperative group members are punished. Results of the fMRI scans showed that the women in the study exhibited an empathy for pain response regardless of the perceived fairness of the player. The males, on the other hand, could be seen to have a diminished and, in some cases, a non-existent empathy for pain response when viewing the unfair players receiving pain. Additionally, in the male group, the predicted reward system activation was recorded. Moreover, there was a significant correlation between the empathy self-report used, the interpersonal reactivity index, and the participants anterior insula and anterior cingulate cortex activations. The higher they had rated their own empathy, the higher the activation was recorded (Singer et al., 2006). These results show how even a relatively short engagement with an individual acting unfairly can come to change the subsequent empathic response later evoked. Moreover, the article points to gender differences that may have a significant impact on not only empathy, but also results in the severe consequence of males receiving positive emotions from viewing painful punishment. This down-regulating of empathy for pain in males may have an evolutionary function, but can lead to severe consequences in modern day society. Whilst it may have been favourable to reward group-cooperation when survival depended much on individuals working together, it can instead produce adverse situations when groups are formed for purposes that are not linked to survival (Singer et al., 2006).
Fairness is far from the only factor that can affect our empathy for pain responses. Contrasting with the decreased response due to the unfairness of others, is the decrease of a response to pain in others seen in healthcare professionals.

In 2010, Decety, Yang, & Cheng conducted a study focusing on empathy for pain responses in physicians by recording event-related potentials (ERPs) whilst presenting a series of images. The participants used as the experimental group in the study were physicians (N=15), and a control group consisted of individuals without any medical training or education within the medical field. For the experiment, they presented an extensive array of images of different body parts being subjected to either painful or non-painful stimulation. Behavioural measures were recorded using the interpersonal reactivity index and the emotional contagion scale, alongside a pain questionnaire. Whilst the results from the behavioural scales and pain questionnaire did not show any significant differences between the two groups, a significant difference was found in one section of the behavioural measures related to subjective ratings the participants had conducted during the experiment itself. The control group has rated unpleasantness as well as pain intensity to the images depicting painful stimulation significantly higher than the physicians in the experimental group. From the ERP study, the control group exhibited results similar to earlier research within the field, that is, waves measured from the ERP in the control group correlated with both pain intensity and unpleasantness. Significant differences between the painful and non-painful conditions were seen in the control groups recordings. The experimental group, on the other hand, displayed no correlation between pain intensity and wave amplitude, and a significantly lower correlation between unpleasantness and activity than the control group. This indicates a regulatory function in physicians where empathy for pain is inhibited when exposed to pain in others. In order to effectively treat individuals in pain without becoming
negatively affected and subsequently lowering work performance and self-well-being, it was hypothesised that this process functions as a coping mechanism for healthcare professionals. Decety et al. highlights a possibility of bias and familiarity of the situations as a possible reason for the results of the study (Decety et al., 2010).

5.2 Intentionality

Intent can profoundly impact how we feel and subsequently react to a given situation. The difference between an intended action and an accidental one can produce varied responses from an onlooker. Thus, the outcome of a situation – say an injury, depending on the circumstances leading to it may evoke a stronger or weaker empathy for pain reaction which is, in turn, significant for our understanding of the phenomenon of empathy for pain. In this section, two articles regarding empathy for pain and intent will be presented and discussed.

In Akitsuki and Decety (2009) empathy for pain was studied in relation to intentionality by exploring how perceiving someone’s agency in another’s pain would affect empathy levels. This was achieved through scanning participants (N=26) using fMRI, whilst simultaneously showing images depicting painful injuries acquired alone by accident or caused intentionally by another individual. A set of non-painful situations with either one or two individuals present in the images were also displayed. The participants were asked to view the images a second time in order to rate how painful they perceived the situations in the images to be. It was predicted that both situations in which an injury had taken place would induce an empathy for pain response, with anterior insula and anterior cingulate cortex activations seen in the fMRI scans. Moreover, Akitsuki and Decety also predicted that other areas, in part related to emotion regulation would produce higher activity when participants viewed the images of the intentionally caused pain condition. Namely, the amygdala, and executive areas responsible for mentalizing including the
medial prefrontal cortex. Results showed that, as predicted, there was an anterior insula and anterior cingulate cortex activation when viewing both pain conditions in relation to the no-pain conditions. Moreover, a multitude of other areas showed significant activation during the intentional pain conditions – notably including the amygdala, medial prefrontal regions, temporoparietal junction as well as the insula. The amygdala and ventral region of the medial prefrontal cortex furthermore showed increased connectivity during the intentionally caused pain condition. The subjective ratings of the perceived pain of the individuals present in the images, which were given by the participants, showed a higher pain rating for the intentionally caused pain conditions. This highlights the modulation prone quality of empathy for pain. By displaying an agent with the intent to harm another, we react with a higher intensity of empathy towards the injured than if an accident had occurred. Similar degrees of pain, with similar injuries, can be displayed in front of us, but with significantly differing degrees of empathy induced (Akitsuki & Decety, 2009).

Up to this point in the thesis, all data presented on empathy for pain has come from fully developed adults. How these mechanisms work, and whether these processes have been developed in children has not been discussed. Decety, Michalska, and Akitsuki (2008) conducted an fMRI study with children between the ages of 7-12 (N=17) in which intentionality and empathy for pain were the points of interest. Much like the study by Akitsuki and Decety (2009) mentioned previously, the procedure involved showing images of painful situations either accidentally caused by the individual getting hurt or intentionally by another, alongside a neutral, non-painful situation. Additionally to these, Decety et al. also included a condition in which, instead of someone intentionally harming another, someone engaged in a helping act towards them instead. It was predicted that watching the painful situations depicted in the images would
activate established empathy for pain areas, namely the insula and anterior cingulate cortex. Furthermore, situations with an active agent either helping or causing harm were expected to produce higher activity in executive and mentalizing areas. Support exists regarding mechanisms of shared affection being present in early childhood, the predictions made in the present study drew from that support. The predictions made were subsequently confirmed in the children’s fMRI scans together with behavioural ratings of pain. The children had rated all painful situations as more painful as the neutral ones, leading to activations in empathy for pain-related areas including parts of the insula, the dorsal anterior cingulate cortex, thalamus, the periaqueductal grey and supplementary motor area. Moreover, viewing images where pain was caused by another lead to higher activation in the temporoparietal junction as well as parts of the amygdala and prefrontal regions (Decety et al., 2008).

The two studies presented on intentionality share similarities in their results. In both studies, anterior insula and anterior cingulate cortex activations occur, indicating empathy for pain. Mentalizing areas, like the temporoparietal junction, indicating perspective taking as well as separation of self from others were active in both studies. Moreover, pain which was induced with the intent to harm activated amygdala as well as prefrontal regions in both adult and child participants. This indicates that the process of empathy for pain as well as recognition of intent develops early in humans (Akitsuki & Decety, 2009; Decety et al., 2008).

5.3 Perspective Taking

How and what we react to and in which way this occurs largely depends on perspective. Both visual perspectives, as well as perspective taking in relation to other individuals, can affect subsequent empathy for pain patterns.
An article written by Lamm et al. (2007) set out to research the effects of perspective taking on empathy by way of behavioural measures and an fMRI study. In the study, Lamm et al. wanted to evaluate individuals who had a high empathy score on both the perspective taking and empathic concern scales of the interpersonal reactivity index, which resulted in a selection of a few participants out of a larger sample (N=17). Together with the interpersonal reactivity index, additional behavioural measures used in the study were the empathy quotient and the emotional contagion scale. The participants were shown video clips that had been rated and predetermined as depicting a painful facial expression beforehand by a separate sample of participants in order to ensure that the videos shown would evoke a strong response. The current group of participants were told that the video clips depicted individuals receiving a painful treatment, resulting in a pained facial expression. They were also informed in which videos the treatment was successful and which were not, as well as what perspective to adopt – imagining oneself in the situation or imagining another in the situation. After the fMRI study, the participants were shown images of the faces used in the experiment, alongside new faces not included in the initial study. The aim was for the participants to select the faces used in the experiment. It had been predicted by Lamm et al. that empathic concern would be higher during the conditions when the participants were asked to imagine others in the situation, whilst the self-imagined condition would elevate personal distress levels. A prediction was also made regarding a higher recall rate of the faces displayed in the video clips that were part of the self-imagined condition in relation to the faces used in the other-oriented condition.

As predicted, viewing the video clips with a self-imagined perspective resulted in higher reported personal distress, while elevated empathic concern was reported during the other-oriented condition. Moreover, the prediction regarding a higher recall of faces used for self-
imagination was confirmed. The effectiveness of the treatment further manipulated the pain intensity as well as unpleasantness ratings given by the participants. Both perspectives were seen to evoke a higher rating when the treatment was told to be unsuccessful. Together with the behavioural ratings, a higher activation in empathy for pain areas was seen in the scans when viewing the unsuccessful conditions. As mentioned, fMRI scans revealed the activation of empathy for pain areas including insular cortices and the anterior midcingulate cortex as well as the amygdala and thalamus. Importantly, scans showed how perspective taking influenced specific activations, including the parietal cortex, an area in part responsible for perspective taking processes. This is in line with previous studies in this area and on its properties. The self-imagined condition produced higher activity in the left parietal cortex and the other-condition evoked activity in the right parietal area. Moreover, the self-condition produced higher activity in affective empathy for pain areas, including the insula and anterior cingulate. These findings reflect how perspective can change the outcome of subsequent levels of empathy for pain. More specifically, taking an other-related perspective evokes empathic concern and may lead to helping behaviour, whilst the self-perspective resulted in elevated distress (Lamm et al., 2007).

Another study of empathy for pain and perspective taking comes from Vistoli et al. (2016). The modulation of empathy for pain was created through changing the visual perspective in images. In their experiment Vistoli et al. manipulated several perspectives surrounding the images, including the subsequent painful or neutral outcome of said images. The participants (N=21) were additionally instructed to either take the perspective of oneself in relation to the situations in the images, or the perspective of another in the situation. Lastly, the situations were either filmed from a first- or third-hand perspective. This was done through changing the angle from which the recording of the images took place. To compare the fMRI scans with individual
degrees of empathy, the interpersonal reactivity index was used as the behavioural measure for the study. As expected, all pain conditions elicited significant activations in empathy for pain-related areas, including the anterior insula and anterior midcingulate cortex. Moreover, there was a significant correlation between the empathy for pain activations and the personal distress subscale of the interpersonal reactivity index. Significant activations were discovered bilaterally in the temporoparietal junction, an area as previously mentioned being involved in perspective taking, only when participants took a first-person perspective when viewing the images. According to Vistoli et al., this finding highlights a significant mechanism in which the visual perspective can modulate subsequent activations when perceiving and empathising with others pain. Additionally, it highlights the importance of the cognitive qualities of empathy and the effects these might have of subsequent affective empathy for pain responses (Vistoli et al., 2016).

5.4 In-Group and Out-Group Relationships

Another aspect of empathy for pain worth taking into consideration is that of social relationships. More specifically, the area of interest lies in group dynamics and the changes in empathy seen toward those outside of this group dynamic.

In an fMRI study by Hein, Silani, Preuschoff, Batson, and Singer (2010) helping behaviour in connection to in- and out-group biases were researched. Although this article is not explicitly about empathy for pain, the results found indicates a difference in empathic responses to an out-group member’s pain. In addition to the fMRI scans, the empathic concern scale of the interpersonal reactivity index was recorded as a behavioural measure. All participants in the study (N=16) were male football fans and were subsequently paired with an in-group member supporting the same football team. The participants were later matched with two out-group
members who supported an opposing team. A separate exercise was conducted with the participants in order to ensure in- and out-group membership affiliation.

In the first fMRI experiment, varying degrees of painful stimulation ranging from low to high was administered to either the participants themselves or to be perceived by the participants when induced in-group and out-group members. Furthermore, the participants were instructed to rate the intensity of the perceived pain. In the second fMRI experiment, participants could choose between several different options when viewing in- and out-group members receiving painful stimulation. The choices were to either engage in costly helping, wherein the participants also received painful stimulation, but to a lesser degree, to ignore the pain in another and watch a video instead, or to watch the other receiving the pain. Hein et al. predicted from the first experiment that perceiving an in-group member in pain would produce anterior insula and anterior cingulate cortex activations, and the extent of this activation would serve as a predictor for how likely the participant would be to subsequently engage in costly helping. Moreover, perceiving out-group members in pain would not elicit activity in empathy for pain areas to the same degree and additionally produce activity in the reward-processing area nucleus accumbens and lead to a lower probability of costly helping (Hein et al., 2010).

High-pain stimuli in the in-group members were rated as significantly higher than the out-group members by the participants. Similar results were seen in the behavioural measure, where empathic concern was rated higher by the participants for the in-group members. Moreover, participants engaged in costly helping more when an in-group member was in pain (Hein et al., 2010).

Activations were found in the anterior cingulate cortex and left anterior insula, which is in line with several empathy for pain studies (e.g. Lamm et al., 2011). As predicted, the
participants with more frequent activations in the anterior insula later went on to engage in more costly helping. A correlation was subsequently established between a high in-group activation of the anterior insula and a low out-group activation of the area when perceiving pain, with a painful costly helping or ignoring of the others pain. Nucleus accumbens activations were seen in the scans of participants who expressed the most bias for out-group members, with a subsequent lower anterior insula activation when perceiving out-group members in pain (Hein et al., 2010). This reflects a lowered empathy for pain response towards out-group members. Moreover, similarities can be seen between this study conducted by Hein et al. and the study on fairness by Singer et al. (2006) in which reward-related areas are activated in males when perceiving pain in a disliked individual.

A study conducted by Forgiarini et al. (2011) explored racial biases with skin conductance responses. Skin conductance response was chosen for the current study due to earlier research indicating that the method is reliable in predicting negative emotional responses. The participants recruited for the study (N=61) were all of Caucasian descent. The hypothesis posed stated that any racial biases seen would be implicit, leading to a weaker empathy for pain response from the participants. To test their hypothesis, Forgiarini et al. used images of actors with different ethnic descents all receiving either painful or neutral stimuli. The ethnic descents chosen were Caucasian, Asian and African. The participant’s physical responses to the images were measured through electrodes attached to their fingers. Throughout the experiment the painful stimulus conditions evoked a higher response than the neutral conditions. Results from the skin conductance response experiment also revealed an overall significantly lower empathy for pain response towards the actors of African descent when compared to both the Caucasian and Asian actors receiving painful stimuli. The subsequent behavioural measures used was in
part a trait empathy scale, alongside a positive and negative association test. The association test served as a measure to find racial biases that could further explain the results of the skin conductance response experiment. Positive and negative words were displayed next to an image of either a Caucasian or African actor, where the participants were instructed to associate words with the images. The results from the experiment and the behavioural reports were further analysed, showing a correlation between a pre-existing racial bias and the subsequent lowered empathy for pain response to individuals with African descents. I.e. participants with a lower racial bias produced higher levels of empathy for pain towards all actors, independently from ethnic descents. Contrastingly, participants who displayed a racial bias had a lower empathy for pain response during the skin conductance response (Forgiarini et al., 2011).

These results reflect a phenomenon with many consequences, where empathy for pain is lowered implicitly through what Forgiarini et al. proposes to be due to differences in familiarity, i.e. appearance or characteristics. Thus, empathy for pain may not only be modulated through perceived acts of fairness that come from evaluation of a person's behaviour (Singer et al., 2006), but also modulated through a deep-rooted racial bias (Forgiarini et al., 2011).

Research has been conducted with an aim to reduce this bias and increase empathy for pain toward out-group members. Two electroencephalography (EEG) studies whose results have subsequently provided ways in which to modulate the bias and in turn increase empathy for others pain will be discussed.

In Contreras-Huerta et al., (2014) racial bias was studied alongside group affiliation, with the aim to see whether assigned group dynamics could counteract the racial bias in individuals. All participants recruited for the present study (N=21) were of Caucasian descent. The participants were told that they were assigned to one of two groups based on a questionnaire they
had previously filled in. Additionally, the participants were told that the out-group had the most differing opinions from themselves. This, in order to strengthen in- and out-group affiliation. Amongst the groups, four actors of Caucasian and Chinese descent were included, two male and two females, divided into the in- and out-groups. EEG recordings were taken with ERPs measured, during which images were presented to the participants. The images depicted all in- and out-group members either receiving a noxious or neutral stimulus. Additionally, a task in which positive and negative words alongside the images of the actors was conducted as a way to measure immediate biases held by the participants. This task confirmed that a higher degree of positive words took a shorter amount of time to associate with faces belonging to targets with the same ethnic descent as the participants themselves, i.e. the Caucasian actors. Subsequently, negative words were faster associated with targets of Chinese descent. Moreover, the results from the EEG study revealed two different types of processing, one automatic bottom-up processing, and a later, top-down mechanism. The early activations seen were significantly correlated with a higher empathy for pain in connection to images depicting an individual of same descent, i.e. the participants reacted more prominently to Caucasian faces in pain compared to Chinese faces in pain. Importantly, the group affiliations created for the current study consisting of individuals with Caucasian and Chinese descent did not affect these early processes. This racial bias could not be seen during the later processing stage. Instead, there was only a significant difference between the painful and non-painful images presented, i.e. whilst the assignment of participants into groups consisting of differing ethnic descents did not affect the bias, it was discovered that said bias could through cognitive strategies be regulated, resulting in an increased empathy for pain response in a top-down manner (Contreras-Huerta et al., 2014).
In Sheng and Han (2012) three experiments were conducted with the aim to decrease negative out-group bias, and these share similarities in design with Contreras-Huerta et al. (2014). In the present study, all participants recruited were of Chinese descent (N=48). The participants were additionally divided into two groups consisting of both Asian and Caucasian individuals beforehand. The interpersonal reactivity index was used as a behavioural measure in the study, alongside subjective ratings of pain intensity, likeability as well as an implicit association task. Images of Asian and Caucasian faces with neutral or pained expressions were presented simultaneously as EEG recordings were made. The first experiment consisted of a race discrimination task, and images were presented with the instruction to pay attention to the descent of the individuals in the images. The second experiment introduced a pain discrimination task where focus was directed to the pained or neutral expressions in the images, alongside another race discrimination task. The final experiment in the study, additionally to the other tasks, used different coloured clothing in the presented images to separate in- and out-group members. The results from the ERP recordings taken by Sheng and Han during the first experiment showed an increased response from the participants to the images of same-race individuals in pain, reflecting a higher degree of empathy for pain (Sheng & Han, 2012). These results share similarities to the studies mentioned previously in this section (Contreras-Huerta et al., 2014; Forgiarini et al., 2011). The bias was decreased through cognitive strategies focussing on the individual and their pained facial expressions instead of ethnic descent, as per instructions from the second experiment. Similar results of the bias disappearing could be seen from the third experiment, where attention was also directed away from racial differences (Sheng & Han, 2012).
In both cases, a decrease in racial bias was achievable through cognitive strategies. The bias could be identified as automatic with changes only appearing at a later stage. The two studies whilst as previously mentioned, similar in design, differ on whether artificial group division has a significant impact on subsequent empathy for pain responses (Contreras-Huerta et al., 2014; Sheng & Han, 2012).

Empathy for pain appears to be a deep-rooted phenomenon, with its capacities developing at an early age. To conclude this chapter, it can thus be said that empathy for pain is prone to modulation (Decety et al., 2008). From that baseline, a large variety of factors subsequently come to modulate the degree of empathy felt and perceived by individuals to another's pain. These factors may come to vary both in complexity and in strength, that subsequently affects the receiver. Empathy for pain shifts from its baseline to either increase or decrease subsequent empathic responses. This can stem from complex cognitive strategies, such as economic games, which seems to affect one sex more than another (Singer et al., 2006), to relatively simple changes in visual angles in which one partakes in perspective taking (Vistoli et al., 2016).

6. Discussion

The aim of this thesis has been to provide the neurocognitive and behavioural findings surrounding empathy for pain, as well as to present research regarding the modulating factors of the phenomenon.

Definitions regarding empathy for pain and related terms have been discussed due to the difficulty of categorising the phenomenon. It in part includes the experience of perceiving felt pain, along with an empathic response as a result. Due to these difficulties, research has been conducted on the relationship between both seen and felt aspects of pain. A range of differences
exist, mainly regarding the direct experience of pain. Many of the sensory areas within the pain matrix only react to directly felt pain, although the affective areas of the pain matrix share common activations between both empathy for pain and felt pain (see, e.g. Lamm et al., 2011; Singer et al., 2004). In contrast, pain synesthetes experience both perspectives. That is, they experience sensory qualities of felt pain whilst viewing another in pain, in contrast to other parts of the population who experience affective qualities of another’s pain (e.g. Osborn & Derbyshire, 2010). Thus, the attempt to categorise whether empathy for pain is a type of felt pain or not faces many problems that are easily avoided by adopting other strategies. Importantly, one of these strategies regards empathy for pain being understood by highlighting the relationship between sensory and affective properties of pain. As such, empathy for pain can be defined as a subjective empathic phenomenon that can arise from the recognition of another individuals experienced pain (Zaki et al., 2016).

Thus, it may not be possible to categorise empathy for pain as a phenomenon as either felt pain or not, but rather that empathy for pain may elicit different experiences depending on the particular situation and individuals involved.

When regarding the neuroscientific data collected through empathy for pain research, mainly by way of fMRI scans or EEG recordings, results show both recurring patterns as well as specific activations depending on the type of variables used and design choices implemented. The neural correlates of empathy for pain, the anterior insula and anterior cingulate cortex, have been established through a significant amount of research recorded and analysed (see, e.g. Lamm et al., 2011; Morrison & Downing, 2007; Singer et al., 2009). Other areas which are active during empathy for pain depend heavily on how the empathy for pain response is evoked. Frequently active areas in empathy for pain research involve the primary and secondary
somatosensory cortices, where visually induced empathy for pain in the form of images of body parts experiencing pain can create mimicry. The temporoparietal junction and prefrontal areas, on the other hand, are commonly associated with research using top-down mechanisms, where mentalizing abilities are needed in order to elicit an empathy for pain response. Typical for all empathy for pain research, regardless of the type of processing evoked in participants, are the primary empathy for pain areas – the anterior insula and anterior cingulate cortex (Lamm et al., 2011).

Another aspect discussed in the thesis has been the behavioural scales used in empathy for pain research (see, e.g. Baron-Cohen & Wheelwright, 2004; Davis, 1983; Doherty, 1997; Giummarrà et al., 2015). Moreover, empathy for pain research has provided support for the correlation between high empathy scores and a higher subsequent empathy for pain response (Lamm et al., 2011). Methodological questions arise from this section, mainly due to the content of the behavioural scales and the specific field of research it is being implemented in. The empathy for pain scale, discussed in section 2.5 ‘Measuring Techniques’ may be useful in future research, as the scale is aimed explicitly at empathy for pain. Research using this scale may provide more accurate results. This, as other empathy scales measure empathy as a whole. These empathy scales encompass many features that may not be relevant in empathy for pain experiments (Giummarrà et al., 2015).

Importantly, the behavioural measures used should reflect the experiment and its aims, i.e. a study on empathy for pain should be coupled with scales measuring behaviour related to viewing another in pain. Whilst other empathy characteristics may be high for participants, they may not be relevant factors for the present study.
When discussing multisensory perspectives, two differing perspectives have been brought up. The first relates to using different sensory modalities to evoke an empathy for pain response, which can then be researched upon (e.g. Jackson et al., 2005; Lang et al., 2011; Morrison et al., 2004; Singer et al., 2004). The use of images or audio evoke empathy for pain responses, indicating that the phenomenon can respond to a multitude of sensory modalities.

The second perspective is far more complicated in nature, relating to somatosensory experiences induced without tactile stimulation (e.g. Fitzgibbon et al., 2012; Goller et al., 2011; Osborn & Derbyshire, 2010; Young et al., 2017). As mentioned, both sensory and affective experiences can be induced in pain synesthetes. This gives rise to questions whether these experiences can be regarded as empathy for pain, or whether vicarious pain responders are experiencing a form of pain due to factors other than empathy. In Young et al., (2017) it was suggested that vicarious pain responders may not experience empathy when viewing another in pain. Rather, it was suggested that anxiety, distress and a need for avoidance was at the basis for the phenomenon. It could be argued, however, that empathy and the processes of anxiety-guided avoidance and distress are not mutually exclusive. Vicarious pain responders may engage in avoidance behaviour due to the felt pain response when witnessing another in pain, and this may occur due to high levels of distress. It can be argued that this does not, however, definitively mean that empathic processes completely vanish. Whilst mimicry of breaths is not present, there still may be cortical activations indicating some form of empathy for pain. This, which would then need to be the subject for further research.

The central theme in this thesis has been to the changes in empathy for pain levels that can be evoked in various ways. The multitude of strategies that come to change how we react to other's pain is relatively simple in contrast to the outcomes that said strategies produce.
Some basic understandings surrounding changes in empathy for pain responses have been found and reviewed. Mainly, that empathy for pain is prone to modulation (e.g. Lamm et al., 2007; Singer et al., 2006; Vistoli et al., 2016). These modulatory factors can stem from instructions or manipulations that researchers implement in their experiments. These reflect how we may change our reactions depending on how we perceive an act or person in a given situation. Further, there are factors that change our responses based on recurring experiences. This is exemplified in Decety et al. (2010) where careers in which pain is a frequent occurrence. This can lead to the development of down-regulatory coping mechanisms or habitual responses (Decety et al., 2010). Other factors are more automatic than those mentioned above. These deep-rooted biases change the empathy for pain response from the offset, with automatic down-regulatory effects. The in-group favouritism is based on familiarity, and thus a complicated mechanism to change before the response occurs (e.g. Forgiarini et al., 2011).

Some questions that may arise from these aspects are related to what can be done to increase empathy by way of modulation, as well as to the consequences arising from modulatory factors. Cognitive strategies can aid in increasing empathy for pain. When regarding racial outgroup bias, the importance lies in education to diminish consequential outcomes. One way to implement change in racial bias is to shift the focus from the group to the individual. To cultivate these cognitive strategies in relevant situations, to form, or reform behaviours and biases (Contreras-Huerta et al., 2014; Sheng & Han, 2012). When regarding modulatory empathy for pain mechanisms, as in the decreased response in physicians, which may favour well-being in those with daily interactions with other’s pain, may bring on consequences (Decety et al., 2010).

That is, although the down-regulation makes it possible for physicians to conduct their daily work, there may be problems with the way empathy for pain modulation occurs.
Developing a decreased empathic response, in general, creates possible future consequences. These consequences can regard a decreased response in a work environment remaining in environments outside, for which the coping mechanism is not needed and may cause harm. Another question thus arises if the decreased empathy for pain response can switch on and off, like clocking in and out of work. If a decreased empathy for pain response can occur in healthcare professionals, it could possibly occur for other individuals in other situations.

Several limitations exist within the literature discussed throughout this thesis. In the TMS study on pain synesthetes conducted by Fitzgibbon et al. (2012) they state their limitations due to a low participant sample. Other limitations in the discussed literature pertain to lacking research within the chosen topic by the authors (Lang et al., 2011). Another limitation occurring is that of unexpected deviating findings in similar research studies, due to differences in design choices (Vistoli et al., 2016).

Future research is needed in order to seek out the origins of the experiences felt by vicarious pain responders, whether it arises due to malfunctioning cortical activation patterns, empathy or other origins (see, e.g. Fitzgibbon et al., 2012; Goller et al., 2011; Osborn & Derbyshire, 2010; Young et al., 2017).

More research may also be needed on how to cultivate a higher degree of empathy for pain. This, in order to increase empathic responses in those whose empathy for pain responses are seen to be diminished, either by racial biases, careers or other impacting factors. By using the empathy for pain scale as a behavioural scale in future empathy for pain research, a more precise relationship between recorded empathy for pain activations and behavioural measures can be made. This, which in turn could provide insights into what behavioural aspects need to be cultivated in order to increase empathy for pain.
7. Conclusion

Research on empathy for pain has developed over two decades, with many findings producing similar results across this time span. Throughout this thesis, the fundamental underpinnings of empathy for pain have been put down, creating a base on which to discuss its impact on our behaviour.

To summarise, empathy for pain as a scientific field has grown exponentially since its birth two decades ago. New insights into its functionality and effects on our social interactions have been made with many indications pointing to the consequences of decreased empathy for pain responses. Finally, in order to create methods aiming to increase our empathic abilities for others pain, further research will be required.
References


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