

## Other Papers

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### Empathy gap – what do we know about empathizing with others' pain?

**Abstract:** *Empathy of pain* as a multi-dimensional process includes sharing and understanding the pain of others in relation to oneself. Subjects in such studies are typically members of western, educated, industrialized, rich and democratic societies. In the literature review that we conducted, we observed that little is known about the empathy for pain in people who are not members of societies with these cultural characteristics. We often understand those who are “similar” to us more easily – ones who belong to “our” cultural circle. However, contact with another culture could help prevent such bias. Group characteristics, such as focus on others, hierarchy preference, or cultural differences in self-constructs, can change the activity of brain regions associated with empathy and compassion. Increasing the diversity of the research participants connected with education level, poverty, industrialization, and respect for basic citizen freedoms seem to be necessary to fully understand the mechanisms that influence the development and operation of empathy.

**Key words:** *empathy*<sub>1</sub>, *pain*<sub>2</sub>, *culture*<sub>3</sub>

#### Background

Most contemporary research in psychology is carried out on subjects that are very often members of western, educated, industrialized, rich and democratic societies (Henrich et al., 2010). However among the countries mentioned above, only 36 are classified as industrialized (including the UK, Japan and the United States, that is, countries where most research subjects are recruited), 17 countries are classified as countries in transition and 107 are classified as developing countries (including China), of which 48 are classified as least developed countries. In developing countries, approximately 75% of children of both sexes attend school; in low-income countries, school attendance is as much as 15% lower. In poorer regions of the world, there are also large disparities between boys and girls, further exacerbating sex inequality (Nugent, 2006). In most behavioral studies, subjects are typically individuals with a university education or they are students (Arnett, 2008; Chiao, 2009). WHO data shows that 925 million

people suffered malnutrition between 2011 and 2013. Most of these people live in developing countries and account for 16% of the human population (according to the United Nations Food and Agriculture Organization). Malnutrition can cause physical and psychological developmental disorders, which later significantly affects individuals' social functioning and understanding of the world around them (Brown & Pollitt, 1996). According to the Freedom of the World (2015) report on democracy and freedom around the world, 89 countries can be considered democratic, 51 partly democratic, and 55 cannot be considered democratic. Thus, as many as 4,328,197,972 people (60% of the world population) live in states that deny basic freedoms to their citizens.

Unfortunately, many studies of empathy ignore the context of culture. Currently, little is known about the process of empathizing among people who are not members of the privileged group. Scientific papers rarely include information about the national or ethnic origin of the subjects (cf. Benuzzi et al., 2008; Costantini et al.,

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2008; Osborne & Derbyshire, 2010; Decety, 2010). These categories are completely ignored in neuroimaging studies of pain empathy. In a meta-analysis of research on pain empathy, Lamm, Decety, and Singer (2011) considered 32 published papers, of which only 5 included people of Eastern origin (3 Chinese and 1 Japanese) (cf. Cheng et al., 2010; Han et al., 2009; Xu et al., 2009; Lamm et al., 2010). In 2 of these cases, all the authors were Chinese, so presumably the subjects were also Chinese, although their national origin is not mentioned (Cheng et al., 2007; Gu & Han, 2007).

### Neurobiology of pain empathy

In most published research papers, empathy is understood as a complex process that plays a key role in social cognition and is necessary to effectively forge and maintain social relationships. Empathy is both sharing and understanding the emotional state of others in relation to oneself (Decety et al., 2008). The process of empathizing is a dynamic ability to attune oneself emotionally to another person, to understand the thoughts and intentions of this person, and to adjust one's behavior in response to another person's emotions (Hoffman, 2006; Batson, 2011; Decety, 2010). Pain empathy has been the subject of a considerable amount of research. Neuroimaging studies show that when we see or imagine the pain experienced by another person, the anterior cingulate cortex (ACC) and the frontal region of the anterior insula (AI), comprising the "pain matrix", become strongly activated (Peyron et al., 2002; Hein & Singer, 2008). This mechanism allows us to feel another person's emotions as our own. However, if we look at the neural pathways that connect these structures to other areas of the brain, we notice differences between actually feeling pain and observing another person in pain. Activation of pathways connecting AI with midbrain and periaqueductal gray (PAG) was observed during pain experienced directly, while pathways connecting medial prefrontal cortex (MPFC) with ACC and AI were activated while the subject observed another person in pain (Zaki et al., 2007).

Another mechanism that allows to understand the thoughts and perspective of another person involves the "top-down" neural pathway, also known as empathic understanding (Decety, 2010). The brain structures that support this mechanism include the temporo-parietal junction (TJP), the superior temporal sulcus (STS) and the temporal pole (TP) (Mitchell et al., 2005; Gallagher & Frith, 2003; Hein & Singer, 2008; Decety, 2010; Jankowiak-Siuda et al., 2011).

Empathizing is also being able to monitor and control the expression of emotions aroused by an observed state of another person, as well as the adjustment of one's behavior to the given situation. Brain structures involved in emotion regulation – orbitofrontal cortex (OFC), medial prefrontal cortex (MPFC), dorsolateral prefrontal cortex (DLPFC) and the anterior cingulate cortex (ACC) – form a network, which feeds information to STS and the amygdala (Decety, 2010; Decety, 2011).

The level of activation of brain areas associated with empathizing varies depending on several factors. For example, Tania Singer (2006) has shown the influence of kinship. The activation of neurons involved in empathy is stronger when the subject is empathizing with a suffering loved one, as opposed to a stranger. Similarity between the subject and the other person, which makes understanding easier, is another important modulator of empathy (Davis, 1999; Bateson et al., 2005).

The aim of this review is to investigate what do we know about pain empathy and its cultural moderators like western vs. eastern, education, industrialization, wealth and respect for basic citizen freedoms with particular emphasis on brain neuroimaging studies.

We will analyze available scientific data in the context of culture, attempting to take into account the diversity of people around the world.

### Method

**Search strategy:** The search covered three literature databases (EBSCO, PsycINFO, GoogleScholar). The following key words were used as the search criteria: pain empathy-neuroimaging-culture, pain empathy-neuroimaging-race, pain empathy-neuroimaging-ethnicity, pain empathy-neuroimaging-education level, pain empathy-neuroimaging-social economic status. In addition, we identified additional references from those provided in identified papers. The search was conducted from October 2015 to February 2016.

**Inclusion criteria:** From 154 abstracts focused on 48 that met the inclusion criteria: (a) they were peer-reviewed neuroimaging comparative research, either experimental or quasi-experimental, (b) used pain empathy paradigm: pain matrix and neural empathy understanding comparative studies.

### Results

Of 48 studies that used neuroimaging as a method of investigating pain empathy, only 10 (21%) explicitly mentioned that the subjects were recruited from non-privileged populations; in 4 cases (8%), one could presume that this was also true. They are summarized in Table 1.

Affiliations of the authors of most studies indicate that the institutions they work for are located in Europe or the United States, and one can only assume that the subjects were also recruited from members of the Western culture. In review articles and meta-studies of empathy, cultural differences are ignored (Lamm et al., 2011; Bernhart & Singer, 2012). Standard descriptions of subjects participating in the study omit information about their origin and race. It would seem that this information is indispensable if such phenomena as the influence of culture on empathy and the ability to read emotions based on facial expressions are to be adequately described and fully understood.

**Table 1. Overview of fMRI studies on empathy indicating origin of study participants**

Brain region of interest	Participants	Source
Pain matrix	454 origin undefined participants	Benuzzi et al., 2008; Bird et al., 2010; Constantini et al., 2008; Danziger et al., 2009; Gu et al., 2010; Jackson et al., 2005; Lamm et al., 2007a; Lamm et al., 2007b; Lamm & Decety, 2008; Land et al., 2011; Michalska et al., 2013; Morrison & Downing, 2007a; Morrison et al., 2004; Morrison et al., 2007b; Osborn & Derbyshire, 2010; Saarela et al., 2007; Simon et al., 2006; Singer et al., 2004; Singer et al., 2006; Singer et al., 2008; Zaki et al., 2007
	167 Caucasians	Azevedo et al., 2013; Botvinick et al., 2005; Cheon et al., 2013; Chiao et al., 2009; Contreras-Huerta et al., 2013; Hein et al., 2010; Immordino-Yang et al., 2009; Preis et al., 2013; Xu et al., 2009
	112 Asians	Cao et al., 2015; Cheon et al., 2013; Wang et al., 2015; Xu et al., 2009; Zuo & Han, 2013
	95 participants (likely Asians)	Gu & Han, 2007; Han et al., 2009; Moriguchi et al., 2007
	26 White participants	Decety et al., 2010
Neural empathy understanding	13 Black participants	Azevedo et al., 2013
	78 origin undefined participants	Akitsuki & Decety, 2009; Jackson et al., 2006
	49 Asians	Cheng et al., 2010; Cheon et al., 2011
Pain matrix and neural empathy understanding	14 Caucasians	Cheon et al., 2011
	368 origin undefined participants	Decety et al., 2008; Decety et al., 2012; Decety et al., 2013a; Decety et al., 2013b; Lamm et al., 2010
	28 participants (likely Asians)	Cheng et al., 2007
	21 Asians	Sheng et al., 2014

### Cultural aspects of pain expression and pain empathy

Culture can be viewed as a key factor affecting our sense of similarity and kinship. Sharing experiences within the same culture can facilitate understanding and emotional resonance. Likewise, the process of acculturation can promote psychological, as well as neuronal change related to feeling what others are feeling and generating emotional expression (Cheon et al., 2010).

Culture determines the range of meanings relevant to pain and suffering and provides models for their expression (Kleinman et al., 1994; Ryder et al., 2008). For example, Hobara (2005) has shown that another person's behavior associated with pain is more acceptable to Americans than to Japanese and to Euro-Canadians than to Chinese (Yi-Cheng Hsieh, 2011). This is likely related to the collectivist orientation of the latter, who perceive negative emotions as a disturbance threatening the group's stability (Matsumoto, 1989). This claim is supported by the lower

acceptance of behavior connected with pain among the Chinese when the experimenter is also Chinese (thus strengthening the cultural context), rather than Westerner (Yi-Cheng Hsieh, 2011). Interestingly, the Chinese assessed their own pain as more intense than did Westerners, exhibiting more non-verbal behavior associated with pain; similarly, African-Americans and Hispanic assessed their own pain as stronger than Caucasians (Yi-Cheng Hsieh, 2011; Sheffield et al., 2010; Hernandez et al., 2006; Edwards et al., 2001). Furthermore, the effect of stronger non-verbal expression was more pronounced when the experimenter was of the same ethnic origin as the subjects (Yi-Cheng Hsieh, 2011).

Cultural context also affects the accuracy of one's assessment of the intensity of pain felt by another person. Experiments suggest that if the person in pain shares cultural background with the observer, it is easier to track changes in the intensity of pain experienced by another person, although Canadians (but also Chinese) estimated the intensity of pain experienced by a Caucasian person

more accurately than if the pain was experienced by a person of Chinese origin. Both groups rated the intensity of the expression of pain lower in other Chinese than in Canadians (*ibid.*). It seems important in this context to distinguish empathy from the perception of pain, as these two processes are mutually independent.

Ethnic origin can change the level of empathy towards individuals of the same and different race (Avenanti et al., 2010). When patients from Europe and America were examined, there was a marked difference in empathy towards suffering individuals of light or dark skin color; empathy was weaker when the person in pain was a member of an ethnic minority; this even led to smaller doses of painkillers being prescribed than if the patient was of the same ethnic origin (Drwecki et al., 2011; Kaseweter et al., 2012; Shavers et al., 2010).

### Cultural aspects of brain pain empathy

When Chinese and Caucasians observe others, with whom they share the same culture, the ACC and AI – the area associated with the neuronal pain matrix, becomes more activated (Xu et al., 2009). This activation dropped precipitously when a pain-experiencing person from a different cultural group was observed (Xu et al., 2009). A similar AI activation pattern was observed in a study with White and Black people (Azevedo et al., 2013). This effect was uninfluenced by groups created by the experimenter (Contreras-Huerta et al., 2013). Perhaps these relationships are due to more accurate perception of non-verbal signals emitted by people with whom one shares the same culture.

It seems that the emotional core of pain empathy is similar in both cultures and differences seen in research are considered as empathy racial bias. However, if people born in China emigrated to the United States or Australia at an early age, this effect disappeared – the level of pain empathy was similar for the Chinese and the Americans. Data indicate that long-lasting contact with another culture can be associated with a higher level of empathy towards members of this culture, in comparison to individuals who had no contact with a different culture. Furthermore, the number of experiences with members of a different culture is important, whereas being close to these people is not important (Zuo & Han, 2013; Cao et al., 2015). Sheng et al. (2014) showed that racial bias may be reduced by focusing on pain judgment instruction, rather than race judgment. When Chinese college students evaluated the race of the person seen in a pain expression, activation of the ACC and AI was stronger for the in-group rather than the out-group. However when they focused on pain evaluation, it resulted in a higher activation of these regions in the out-group, reducing the racial bias (Sheng et al., 2014, see also Sheng & Han, 2012).

When neural responses in Koreans and Americans were compared, people who showed stronger “focus on others” in a self-assessment questionnaire also showed higher activation of the pain matrix while they viewed photographs depicting members of both cultures suffering emotional pain (Cheon et al., 2013). Aspects associated

with mutual dependence could be more important in collectivist, rather than individualistic, cultures. Focus on others could be related to how quickly and spontaneously individuals are ready to empathize with others (Cheon et al., 2013). Also cultural values like hierarchical and egalitarian social relation preferences change ACC and AI reactions to others pain. The stronger the preference for hierarchy the weaker the activation of the pain matrix (Chiao et al., 2009).

Culture also play an important role in the recognition of emotions felt by others. Adams and his colleagues (2010) measured the accuracy with which American and Japanese subjects were able to recognize mental states in other individuals belonging to these two cultures. They noted that when subjects were asked to observe the expression of someone’s eyes and then indicate on this basis what that person was thinking or feeling, they assessed the mental states of people from the same culture more accurately. When their brain activity was examined, it was shown that their superior temporal sulcus (STS) – which is involved in the understanding of emotions and perspective of another person – was activated more strongly in these cases (*ibid.*). Likewise, when the subject watched the face of a person from the same cultural circle experiencing pain, brain regions associated with perspective taking – such as MPFC and TPG – were also more active. This reaction pattern was observed in Koreans and Americans (Cheon et al., 2011; Cheon et al., 2013). Perhaps these relationships are due to more accurate perception of signals emitted by people with whom one shares the same culture. However, the Yi-Cheng Hsieh (2011) study of the way Chinese and Westerners underestimate pain felt by the Chinese seems to show that this is more likely the result of empathy towards close relatives being stronger. Subjects born in Korea, but not Americans, exhibited stronger activation of brain areas associated with empathy and of the region associated with understanding the thoughts of another person – the left TPJ – when they observed suffering Koreans as opposed to suffering Americans. The activation of the left TPJ is also associated with greater preference for hierarchical power structures and in-group bias (Cheon et al., 2011), and with taking the perspective of a stranger, compared to loved one, at least in Chinese (Cheng et al., 2010).

Other results show that self-constructs may play a role in empathizing. Independence and interdependence probably change the way of distinguishing self from the other. Priming independent or interdependent self-construct differentiates pain empathic reactions from the first-person perspective. In Westerners, who are considered to be more focused on the self, priming independence (words like: I, mine) decreased fronto-central activity, connected with the automatic component of empathy, when witnessing hands in pain. The brain activation of Chinese was different – decreased fronto-central activity was observed after priming interdependence (We, our) in female students (Jiang et al., 2014). However, Wang et al. (2015) primed interdependence in Chinese and observed a stronger activation of midcingulate cortex (MCC), insula, and left supplementary motor area (SMA) while watching in-group

subjects in pain, as compared to the out-group. These activations were decreased after priming independence. It seems that interdependent self-constructs highlight differences between us and them, and in consequence enhance empathy racial bias, whereas independent self-constructs weakens group borders by focusing on self-other distinctions (Marcus, Kitayama, 2010). Zhu and Han (2008) showed differences in MPFC activation when representing self in Westerners, but in Chinese the area was activated for self and close others. Stronger MPFC activation was also observed in Koreans, who manifested stronger focus on others, while in Americans, there was no such relationship (Cheon et al., 2013). Varnum et al. (2014) evaluated responses in the ventral striatum (a structure associated with reward) after priming different self-constructs in Chinese individuals. When priming independence, the ventral striatum was activated more strongly when a subject won money, however, after priming interdependence, the structure was active for self and for a friend. This finding indicates that stable cultural differences in self-construct interacts with a temporarily induced one (Varnum et al., 2014).

### Conclusions

Empathy includes coming to feel as another person feels (Batson, 2011; Hoffman, 2006; Decety, 2010) and imaging how one would think and feel (Batson, 2011; Singer & Klimecki, 2014). Being able to compare people from different cultures and to control for their origin is particularly important when empathy is studied.

We recognize emotions of people with whom we share the same culture more accurately (Elfenbein & Ambady, 2002). A similar pattern was observed in brain neuroimaging studies – the core structures associated with pain empathy are similar in both cultures, however, differences in activation strength are considered as empathy racial bias. In review we showed how culture, that is a key factor affecting our sense of similarity and kinship, but also imposes values, like focus on others or hierarchy preference, modulate empathy. Perspective taking might be moderated by culture values. Asians exhibited stronger activation of brain areas associated with understanding the thoughts of another person (Cheon et al., 2011) and taking the perspective of a stranger, as compared to a loved one (Cheng et al., 2010). Also priming independent or interdependent self-construct change the level of brain activation differently in Westerners and Chinese (Jang et al., 2014; Wang et al., 2015).

There are many other differences between people resulting from different living conditions, related to education, poverty, industrialization, and respect for basic citizen freedoms. However as we showed in the review, little is known how they affect empathy. In addition, the authors do not pay enough attention to the diversity of subjects and their descriptions in publications. It is highly likely individuals who live in different environmental conditions and follow different rules in everyday social interactions will also differ in terms of neural mechanisms

of development and action. For example it is unclear how socioeconomic status (SES) may influence empathic processes. Recent research shows that the higher the SES, the lower the empathy level (Varnum et al., 2015), however, other studies indicate that the higher neuronal responses to pain in people with high subjective socioeconomic status made for higher charity donations (Ma et al., 2011), whereas the higher neuronal response in people with low subjective socioeconomic status, the lower the donations (Ma et al., 2011). Increasing the diversity of the research participants for education, industrialization, wealth and democracy factors seem to be necessary to fully understand what empathy is and how it affects the relationships between people.

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