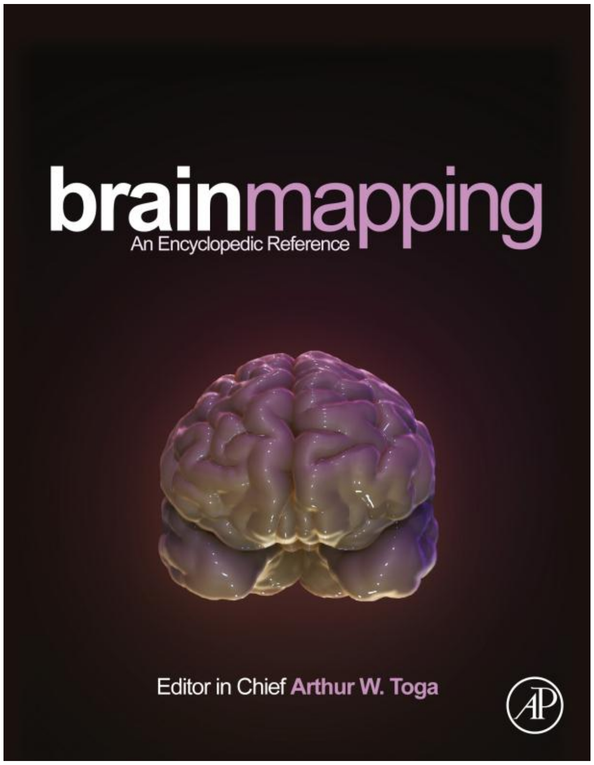

Klimecki O.M., and Singer T. (2015) Compassion. In: Arthur W. Toga, editor. *Brain Mapping: An Encyclopedic Reference*, vol. 3, pp. 195-199. Academic Press: Elsevier.

Compassion

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Situations in which we witness another person suffering are abundant. Most of us are confronted with human suffering on an everyday basis. A very common situation is passing by a homeless person in the street. How do we react? Are we appalled by this person's appearance or do we want to approach the homeless person and be kind?

Being faced with suffering can elicit different reactions. One of them is compassion. Compassion can be defined as "the emotion one experiences when feeling concern for another's suffering and desiring to enhance that individual's welfare" (Keltner & Goetz, 2007). This definition entails three central notions: firstly, it is an emotional reaction to another person's suffering; secondly, it is an affective experience of kindness for the other; and thirdly, it comprises a motivation to act prosocially.

As such, the notion of compassion differs from similar yet distinct constructs such as empathy and empathic distress. In this article, we begin by delineating compassion from these other constructs. This is followed by a short review of psychological research on compassion, focusing on the influence of compassion on prosocial behavior and well-being. The main part of this article gives an overview of neuroimaging studies on compassion that includes recent research on compassion training studies.

Empathy can be defined as the capacity to vicariously share another person's emotion without confusing it with one's own emotional state (de Vignemont & Singer, 2006). Empathic sharing does not depend on the valence of the emotion. One can thus empathize with happiness and sadness alike. When being confronted with suffering, there is, however, a crucial difference between empathy and compassion: while empathy denotes sharing the same affective experience (i.e., suffering *with* the target), compassion describes a non-shared experience, that is, feeling concern *for* the target (Batson, 2009; Singer & Lamm, 2009). In addition to compassion, empathy for suffering can also induce empathic distress. Empathic distress occurs when witnessing the suffering of others, leads to experiences of distress in the observer (who initially was not suffering). The terms 'empathic distress' (e.g., Davis, 1983) and 'personal distress' (e.g., Batson, 2009) have very similar meanings. Likewise, when describing states that are similar to the current notion of compassion, some authors use the term 'sympathy' (e.g., Eisenberg, 2000), whereas others refer to 'empathic concern' (Batson, 2009; Davis, 1983). For clarity, we summarize the terms denoting similar reactions to suffering and make a distinction between compassion, empathic concern, and sympathy on the one hand and empathic distress and personal distress on the other hand (see **Figure 1**). As we discuss in more detail in the succeeding text, psychological research suggests that whereas a compassionate response is associated with positive emotions and increased prosocial motivation, empathic distress denotes an aversive experience accompanied by withdrawal motivation. This difference in definition already suggests that compassion may have great potential for overcoming excessive empathic distress.

Psychological Research on Compassion

In psychological research, the relationship between emotional reactions to suffering and altruistic acts has received considerable interest (for more detailed descriptions, e.g., Batson, 2009; Goetz, Keltner, & Simon-Thomas, 2010). Social psychologists established that emotional reactions to suffering can have opposing effects on altruistic behavior: Whereas feelings of empathic distress in response to suffering have led to self-oriented withdrawal responses, empathic concern for others has been observed to augment helping rates (e.g., Batson, Fultz, & Schoenrade, 1987; for review, see Batson, 2009). Similar links have been found in developmental literature where children's facial displays of distress were negatively related to their helping behavior (Eisenberg et al., 1989).

Extending this cross-sectional research, recent studies have explored whether compassion can be trained and what effects compassion training has on behavior and neural activations. To foster compassion, many studies have employed contemplative techniques that aim at strengthening feelings of warmth and care. One of the more widely used techniques stems from Eastern contemplative traditions and is called 'loving-kindness' training (e.g., Salzberg, 2002). This training focuses on fostering an attitude of friendliness and benevolence, as one usually experiences in relation to close loved persons. The aim of the training is to extend feelings of friendliness and benevolence toward other beings. Using this form of meditation, some pioneering work revealed that 7 weeks of regular loving-kindness meditation practice increased positive emotions and personal resources (Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008). These changes were associated to increased life satisfaction and decreased depressive symptoms, which suggests that loving-kindness training has the potential to improve well-being.

To test whether such a form of compassion training can also augment prosocial behavior, Leiberg, Klimecki, and Singer (2011) compared spontaneous helping behavior in a novel computer task (the Zurich Prosocial Game) before and after a compassion training of a few days. Participants who underwent compassion training indeed increased their helping behavior, while no such effect was observed in an active memory control group. In addition, the increase in the altruistic helping of the compassion group was linearly related to the amount of time participants practiced compassion. This suggests that cultivating compassion particularly fosters altruistic behavior. Similar results were reported by Weng et al. (2013):

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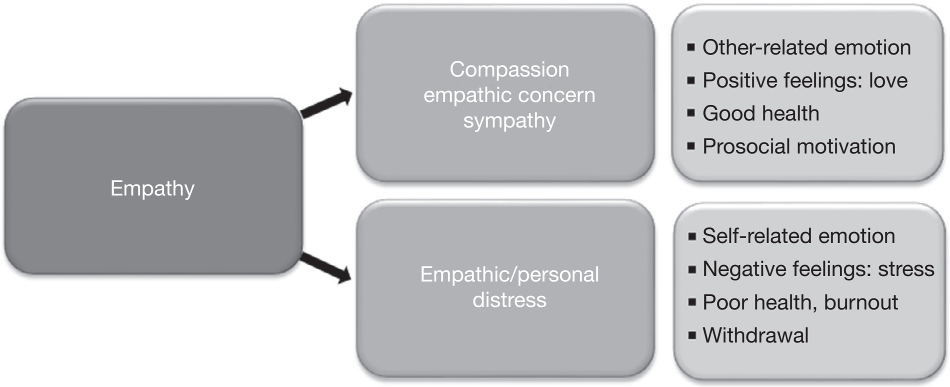

Figure 1 Schematic model showing the potential consequences of empathy for suffering. Reproduced from Klimecki, O., & Singer, T. (2011). Empathic distress fatigue rather than compassion fatigue? Integrating findings from empathy research in psychology and social neuroscience. In: Oakley, B., Knafo, A., Madhavan, G., & Wilson, D. S. (Eds.) *Pathological altruism*. New York, NY: Oxford University Press. By permission of Oxford University Press, USA.

in their study, 2 weeks of compassion training augmented altruistic behavior in response to a norm violation in an economic exchange game. Finally, Condon, Desbordes, Miller, and DeSteno (2013) measured the effects of a compassion meditation course on helping behavior. To assess helping behavior in a real-life situation, the researchers measured whether participants spontaneously offered their seats to a person in crutches. Confirming the beneficial effects of meditation training on prosocial behavior, participants who had undergone meditation training offered their seat to the person in crutches more often than participants in the waitlist control group.

Taken together, these studies support the notion that compassion is related to positive affect and that compassion fosters prosocial behavior. Importantly, the longitudinal studies revealed that the cultivation of compassion can increase well-being and prosocial behavior. This underlines the transformative potential of compassion.

Neuroscientific Research on Compassion

For many years, human neuroscientific research mainly focused on the investigation of cognitive and sensory phenomena. In the past decade, growing interest turned to the delineation of neural mechanisms underlying emotions and social cognition. One prominent example in this field is the study of empathy (e.g., Singer et al., 2004; Singer & Lamm, 2009; Singer, 2012), which was recently complemented by neuroscientific investigations on compassion. Summarizing several original research papers in the domain of empathy, two recent meta-analyses concur that empathy for the pain experienced by another person crucially involves activations in anterior insula and anterior middle cingulate cortex (Fan, Duncan, de Greck, & Northoff, 2011; Lamm, Decety, & Singer, 2011). Furthermore, the degree of anterior insula and medial cingulate cortex activation has been consistently observed to be associated with reports of negative affect (Lamm et al., 2011). In light of the earlier-discussed psychological evidence for differences between empathy and compassion, the question arises as to whether these two similar yet distinct social emotions can be distinguished on a neural level.

In an attempt to delineate the neural correlates of compassion, first cross-sectional studies investigated how adopting compassionate attitudes influences neural activity as measured by means of functional magnetic resonance imaging (fMRI). Beauregard, Courtemanche, Paquette, and St-Pierre (2009), for instance, observed that adopting a stance of unconditional love toward persons with intellectual disabilities augmented activations in the middle insula, the dorsal anterior cingulate cortex, the globus pallidus, and the caudate nucleus. In another study, Kim et al. (2009) found that adopting a compassionate attitude toward sad faces was associated with increases in activations of the ventral striatum and the ventral tegmental area/substantia nigra. These results align with previous findings on the involvement of the middle insula and the striatum in romantic and maternal love (Bartels & Zeki, 2000, 2004). In other words, these findings suggest that compassion may indeed be distinct from empathic sharing of pain. These studies on the effects of adopting a compassionate attitude were complemented by a cross-sectional study on the effects of long-term compassion training in expert meditators (Lutz, Brefczynski-Lewis, Johnstone, & Davidson, 2008). Here, the researchers observed that when exposed to distressing sounds, expert meditators displayed stronger activation in middle insula than novice meditators.

Recently, longitudinal training studies were conducted to test how several days of compassion training can shape reactions to the suffering of others on a neural and experiential level (Klimecki, Leiberg, Lamm, & Singer, 2012). Using a newly developed task that shows documentary videos of others in distress (the Socio-Affective Video Task, SoVT), participant's neural and affective responses were repeatedly measured and compared with an active control group. Prior to the intervention, participants reported that witnessing the suffering of others evoked strong negative emotions and empathy. Several days of compassion training, however, augmented positive emotional responses to the suffering of others, while leaving negative emotional reactions unchanged. In addition, the compassion training led to increased neural responses to suffering in areas that comprise the medial orbitofrontal cortex, pallidum, putamen, and ventral tegmental area/substantia nigra (VTA/SN) (**Figure 2**). These training-related effects were specific, as they were not observed in an active memory control

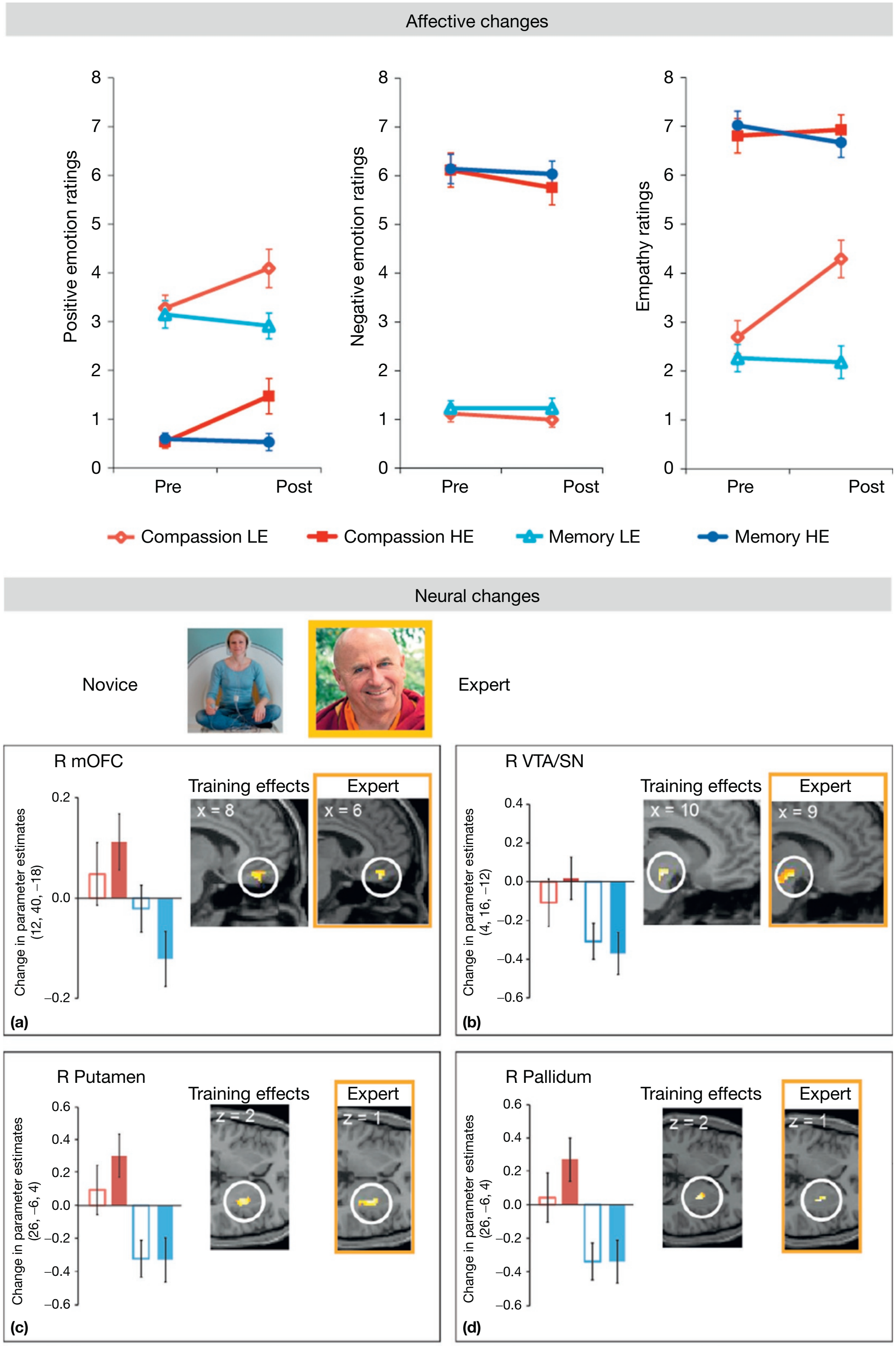

Figure 2 Effects of compassion and memory training. (Upper panel) Self-report changes related to compassion training (red) and memory training (blue). Compassion training, but not memory training, increased self-reported positive affect in response to videos showing people in distress (high emotion, HE) and to videos showing people in everyday life situations (low emotion, LE). No changes were observed for negative affect ratings. Compassion training also increased empathy ratings for LE videos. (Lower panel) Neural activation changes in response to others suffering (HE videos) induced through compassion training occurred in (a) the right medial orbitofrontal cortex, mOFC, (b) the right ventral tegmental area/ substantia nigra, VTA/SN, (c) the right pallidum, and (d) the right putamen. Bar charts show the change in parameter estimates for the training groups in the depicted independent region of interest; error bars denote the standard errors of the mean. Orange boxes show neural activations of an expert practitioner immersed in three compassionate states to a high as compared to a low degree. Reproduced from Klimecki, O., Leiberg, S., Lamm, C., & Singer, T. (2012). Functional neural plasticity and associated changes in positive affect after compassion training. *Cerebral Cortex, 23*(7), 1552–1561, by permission of Oxford University Press.

group. Moreover, similar compassion-related activation patterns were observed in an expert meditator during intense immersion in compassionate states. It thus seems that training compassion augments neural activation in regions that in previous studies have been related to positive affect in general (Kringelbach & Berridge, 2009), as well as to affiliation (Strathearn, Fonagy, Amico, & Montague, 2009) and compassion in particular (e.g., Beauregard et al., 2009; Kim et al., 2009). In addition to augmenting positive affect, a recent study (Mascaro, Rilling, Negi, & Raison, 2013) has shown that compassion training, but not an active control training, can specifically increase scores in an empathy accuracy task (Reading the Mind in the Eye Test). In the control group, the researchers observed activation decreases in brain regions related to the empathy accuracy task (the inferior frontal gyrus and the dorsomedial prefrontal cortex), whereas no such decrease was present in the compassion training group. These results complement existing findings as they point out that in addition to augmenting positive affect, compassion has the potential to improve empathic accuracy.

Despite these advances in our understanding of the neural function underlying compassion and compassion training, it was unclear for a long time in how far the functional neural signature of empathy and compassion differs. To unravel this question, a recent longitudinal study investigated the difference between training empathy and compassion (Klimecki, Leiberg, Ricard, & Singer, 2013). One group of participants was first trained in empathically sharing other's pain before receiving a compassion training in a second step. Before the first training and after each training, participants were exposed to videos depicting others suffering (the SoVT), while their brain activation was measured by means of fMRI. Furthermore, participants indicated to which extent they experienced empathy, positive affect, and negative affect. To control for unspecific effects of social interaction and repeated measurement, an active control group underwent the same measurements but received two separate days of memory training, which also required the engagement in mental imagery. As expected, empathy training augmented the experience of empathy and negative affect. On the neural level, empathy training, but not memory training, increased neural responses to suffering in areas that comprise the insula and the anterior middle cingulate cortex (**Figure 3**). This is remarkable, as it shows for the first time that training empathy can increase brain activations observed in cross-sectional empathy for pain studies (Fan et al., 2011; Lamm et al., 2011). Conversely, a subsequent compassion training with the same participants changed this pattern: on the experiential level compassion training increased positive affect and decreased negative affect to pre-training levels. In terms of neural function, compassion training augmented brain reactions to suffering in areas that encompass the medial orbitofrontal cortex, the pregenual anterior cingulate cortex, and the ventral striatum (**Figure 3**). This is remarkable in two ways: first, distinct neural networks were engaged in empathy and compassion training, suggesting that empathy and compassion in relation to the suffering of others are in fact relying on different brain circuitries. Second, brain regions observed to increase after compassion training have been repeatedly linked to positive affect (Kringelbach & Berridge, 2009) and affiliation (Strathearn et al., 2009). As this change is even present while participants face others in distress, this result underlines that

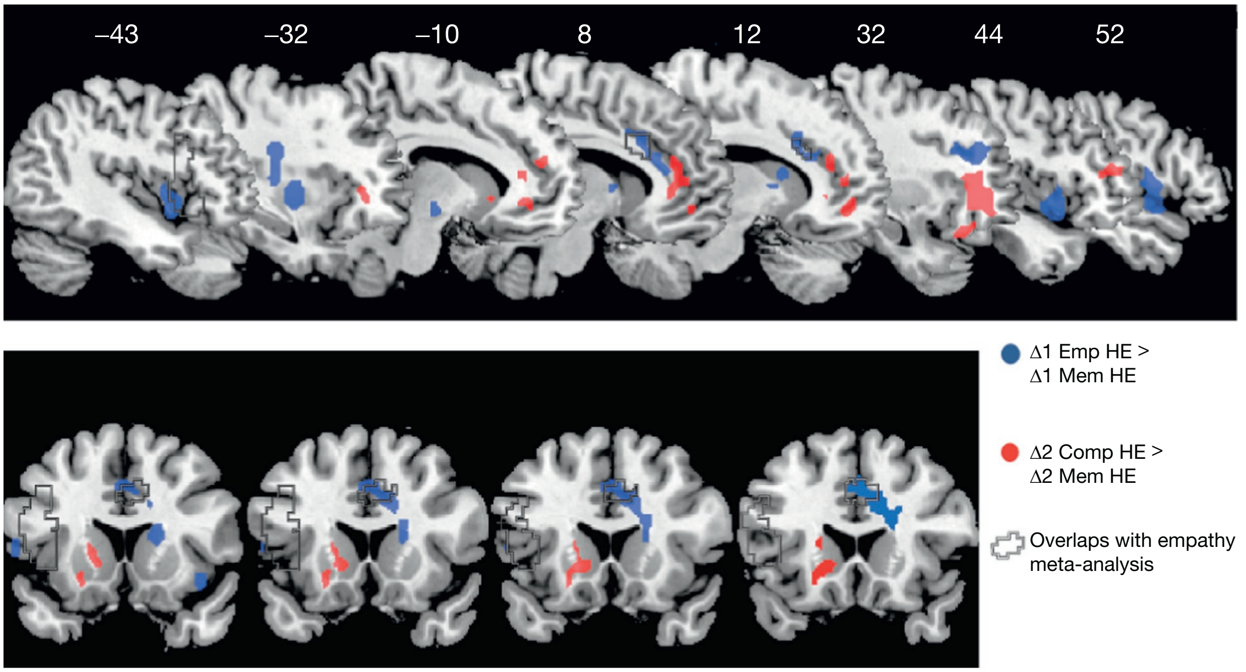

Figure 3 Functional neural changes related to empathy (blue) and compassion training (red) in comparison with the memory control group ($p < 0.05$, FWE corrected). Regions in which changes related to empathy training overlap with a recent meta-analysis on empathy for pain (Lamm et al., 2011) are indicated by dashed lines. Reproduced from Klimecki, O., Leiberg, S., Ricard, M., & Singer, T. (2013). Differential pattern of functional brain plasticity after compassion and empathy training. *Social Cognitive and Affective Neuroscience*, *9*(6), 873–879, by permission of Oxford University Press.

compassion training can buffer the stressful effects of witnessing suffering. Taken together, recent evidence from psychological and neuroscientific research suggests that compassion training may be a very potent method to strengthen resilience and even counteract first symptoms of burnout.

See also: **INTRODUCTION TO SOCIAL COGNITIVE NEUROSCIENCE**: Empathy.

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Relevant Websites

www.compassion-training.org – E-Book on Compassion Training.