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Review article

# The neuroscience of empathy and compassion in pro-social behavior

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ABSTRACT

Research in the scientific literature increasingly demonstrates that empathy consists of multiple dimensions, and that defining empathy as a single encompassing term may be imprecise. Recent calls have been made for increasing empathy as means to increase pro-social behavior. However, contradictory evidence exists that empathy may reduce pro-social behavior. This debate has sparked confusion around what is empathy, along with the value of empathy in promoting pro-social behavior. This paper will examine recent advances in affective neuroscience to better understand the construct of empathy and its relationship to pro-social behavior. Individuals' responses to affective empathy, seeing the suffering of others can result in personal distress or empathic concern, which may then subsequently affect motivation for pro-social behavior. Current research in affective neuroscience suggests that combining compassion interventions in conjunction with both affective and cognitive empathy offers the most optimal likelihood that individuals will engage in pro-social behavior.

## 1. Introduction

Traditionally, empathy has often been considered an important motivating factor for moral and just (pro-social) behavior (Decety and Cowell, 2014, 2015; Hoffman, 2001; Lockwood, 2016; Vachon et al., 2014). However more recent research has challenged this assumption (Decety and Yoder, 2016; Vachon et al., 2014), some scholars even suggesting that empathy has an adverse effect on pro-social behavior (Bloom, 2017). Suggesting the relationship between empathy and pro-social behavior may be more confusing and complex than previously considered. Since altruism or pro-social behavior is important for a well-functioning society (Aknin et al., 2015), and even of benefit to the individual (Curry et al., 2018), understanding the antecedents around pro-social behavior is valuable. In the research reviewed the terms altruism and pro-social behavior are used interchangeably. Altruism involves a selfless concern or moral regard for others as the motive in helping others. Since it is hard to ascertain one's true motivates for pro-social behavior, the terms pro-social behavior/altruism are used without attribution for why participants may be engaging in these helpful actions. The following sections will examine the various facets of empathy based on neuroscience and its effects, as well as their relationship to pro-social behavior. Finally, the paper will investigate how each aspect of empathy could fit together creating a model (see Fig. 1) to improve pro-social behavior. This model is based on de Waal and Preston (2017) model, which suggests that there are three components of empathy, (1) emotional contagion/mimicry, (2) empathic concern requiring self-regulation, and (3) perspective taking; and that they are part of a developmental evolutionary process (in that order), where species sequentially develop more sophisticated brain processes to support empathizing with one another.

## 2. What is empathy?

In broad terms, empathy is other-oriented, as it encompasses the ability to understand and to vicariously experience the feelings of another person (Decety and Cowell, 2014; Lockwood, 2016; Walter, 2012; Vachon et al., 2014). A consistent definition of empathy does not yet exist in the literature, often containing overlapping concepts of sympathy, emotional contagion, and compassion (Bošnjaković and Radionov, 2018; Cuff et al., 2016; Hall and Schwartz, 2019; Lamm et al., 2019). A recent meta-analysis of the term empathy found large varieties in its conceptualization; empathy has been defined as having one a single feature, two defining features, or multiple defining features (Hall and Schwartz, 2019). Furthermore, whether empathy and pro-social

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behavior were similar or different constructs varied in the literature as well (Hall and Schwartz, 2019). Empathy can be better evaluated by examining the brain regions that activate during the various tasks associated with empathy. The neuroscience literature consistently demonstrates that two distinct types of empathy emerge; affective empathy and cognitive empathy, which appear to be functionally and regionally specific (Shamay-Tsoory et al., 2004).

Affective empathy (I feel your pain or joy) is sharing the emotional state of another and has been also referred to as experience sharing in the literature at times (Zaki and Ochsner, 2012). Some scholars view affective empathy to be different from emotional contagion (automatic convergence to another's emotional state), in that it involves recognizing the source of the emotion is outside of the self (Walter, 2012), while others see emotional contagion and affective empathy as similar (Nummenmaa et al., 2008). In reviewing the literature Hall and Schwartz (2019) find experiencing sharing/emotional contagion as being defined in three different ways; one, experiencing the same emotion as another; two, experiencing an emotion that was triggered by observing another's emotion, but not necessarily that same emotion; three, a general physiological or emotional response to an emotion or an emotional situation. Making not only the terms affective empathy, experiencing sharing, and emotional contagion difficult to distinguish between, but also the exact definition of each term is unclear within the literature. Emotional mimicry has also been confused with emotional contagion (Hess and Blairy, 2001). Emotional contagion happens without intention and there is no self/other distinction. Hess and Fischer (2014) make an important distinction between the two, emotional contagion involves matching the subjective emotional experience, while emotional mimicry refers only to matching the nonverbal display of emotion of the other. An example of emotional mimicry is how infants mimic the emotional expressions of those around them, without experiencing the emotional state. It has been suggested that when we mirror others' reactions it strengthens our mutual affiliation and may be done to reinforce social bonds or to help one better understand the emotion (Hess and Fischer, 2013).

Empathic concern and personal distress are also considered to be facets of affective empathy (Fabi et al., 2019; Israelashvili et al., 2020). Empathic concern is considered to be different from emotional contagion. With emotional contagion, there is no self/other distinction, whereas in empathic concern the individual recognizes their emotional response is coming from outside themselves (Cuff et al., 2014). Personal distress is self-focused (Batson, 1990; Fabi et al., 2019). Personal distress involves having a negative emotional reaction to another's suffering. Some researchers link personal distress with emotional contagion (Preston and de Waal, 2002). Empathic concern is also considered to be related to pro-social behavior (FeldmanHall et al., 2015). Singer and Klimecki (2014) suggest that the individual's ability to generate compassion determines whether they respond to another's troubles with empathic concern or personal distress. Compassion may act as a secondary step in self-regulating emotions to reduce the uncomfortable feelings evoked by seeing another in distress (personal distress). This will be discussed further when we look at the role of compassion in empathy.

Cognitive empathy (I know you are experiencing pain or joy) has also been referred to as mentalizing, theory of mind, or perspective taking (Völlm et al., 2006). Cognitive empathy is distinct from affective empathy on a neural network level (Stietz et al., 2019). Cognitive empathy involves the individual's ability to understand another's experience by taking another's perspective. Cognitive empathy may help one person put in context the feelings of another. Cognitive empathy in the absence of affective empathy enables understanding of what another is feeling without necessarily vicariously experiencing the same emotion. This is commonly included in the description of psychopathy, in which an individual has intact cognitive empathy, and can understand and manipulate another's feelings; but lacks affective empathy and therefore has no concern for the emotional state of the other (Lockwood, 2016; Vachon et al., 2014). It has been suggested that conditions like autism spectrum disorders (ASD) may show the opposite pattern of intact affective empathy and impaired cognitive empathy (Dziobek et al., 2008; Lockwood, 2016). However, differences in affective empathy have also been found within ASD. Some authors found no difference in affective empathy between healthy controls and the ASD participants (Hadjikhani et al., 2014), others suggest normal affective empathy for positive emotions and impaired affective empathy for negative emotions (Mazza et al., 2014), while another group of studies finds an exaggerated affective empathy response (Fan et al., 2014; Gu et al., 2015), supporting the empathy imbalance theory of autism (Smith, 2009).

It has been conventional wisdom that affective empathy (feeling another's pain) directly relates to the care for another human being (pro-

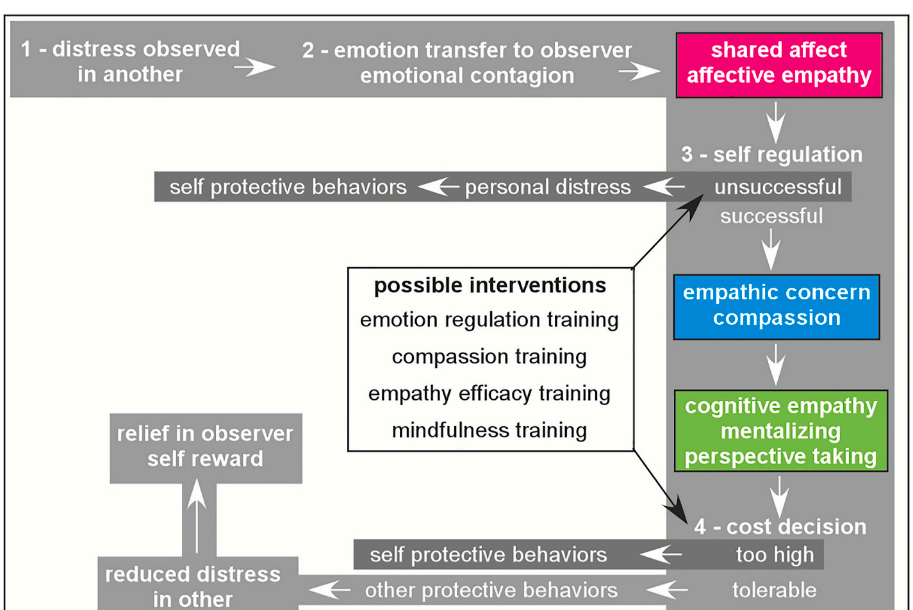


**Fig. 1.** Translating empathy to pro-social behavior.

social action) (Hoffman, 2001). Barack Obama (Honigsbaum, 2013) and others (Hall and Leary, 2020) have identified an empathy deficit, with the idea being more empathy can improve social conditions for all. However, a recent meta-analysis showed that most measures of empathy were unrelated to aggressive (antisocial) behaviors, and that increasing individual's empathy does not decrease anti-social behavior (Vachon et al., 2014). Some studies have found that empathy does not increase pro-social behavior (Jordan et al., 2016). A recent study explored the complex relationship between dimensions of empathy (perspective taking, empathic concern, personal distress) and dimensions of justice sensitivity (reaction to another experiencing unfair events, reaction to being treated unfairly, reaction to personally benefiting from unfair events) (Decety and Yoder, 2016). Sensitivity to justice for others was predicted by both perspective taking (cognitive empathy) and empathic concern (compassion), but not by personal distress (emotional contagion). The authors noted, the possibility that high levels of personal distress may be more likely to motivate self-protective (antisocial, withdrawal) rather than other-protective (pro-social, helping) behaviors. The authors also suggested that educational interventions to promote fairness be directed toward more cognitive aspects of empathy rather than emotional sharing.

## 3. The neuroscience of empathy

With the recent growth of affective neuroscience research, a more nuanced view of the different facets of empathy is being developed, allowing researchers to tease apart the components of empathy, compassion, and pro-social behavior based on the brain responses. The multidimensional nature of empathy is not germane to a single neurobiological process. Functional neuroimaging research indicates that different components of empathy are associated with several related yet distinct brain processes marked by co-activation amongst brain regions (Lamm et al., 2019). The majority of studies have focused on empathy evoked by some type of pain (Fan et al., 2011; Lamm et al., 2011), and this research supports the affective and cognitive empathy distinction (Jauniaux et al., 2019; Kanske et al., 2016).

Affective empathy for vicarious pain (seeing someone else in pain) is associated with the activation of areas that are also activated by experiencing pain, particularly the anterior/mid cingulate cortex (aMCC) and anterior insula (aI) (see Fig. 2). One group utilizing multivariate pattern analysis reported that felt and vicarious aversive experiences evoked shared patterns of activation in the same regions (left lateralized) (Corradi-Dell'Acqua et al., 2016). The aI and aMCC are commonly co-activated comprising what is known as the salience network, a region activated for stimuli that are important or "salient" to individuals (Menon and Uddin, 2010; Menon, 2015). Within the insula, distinct regions exist. The posterior insula (pI) involves an interoceptive awareness of body states (Craig, 2002), while the aI involves a more evaluative component to the perception of pain or emotion (Yarkoni et al., 2011). Jackson et al. (2006) suggest that within the left insula the posterior area is more related to personal experience of pain while more anterior regions would be associated with other's pain. Some evidence demonstrates that personal distress is associated with pI activity (Zhao et al., 2020). Additionally, authors have suggested increased connectivity between the left pI and dmPFC seen in personal distress is representative of individuals mistaking other's feelings as their own (Cheetham et al., 2009). Furthermore, comparing studies with pain empathy cues vs. other negative states, the aI responded to both conditions, while the mid-insula showed greater activation for pain only cues (Timmers et al., 2018).

Cognitive empathy is associated with activations in areas associated with mentalizing and theory of mind, including the dorsomedial prefrontal cortex (dmPFC), ventromedial PFC (vmPFC), temporoparietal junction (TPJ), superior temporal sulcus (STS), and temporal pole (TP)

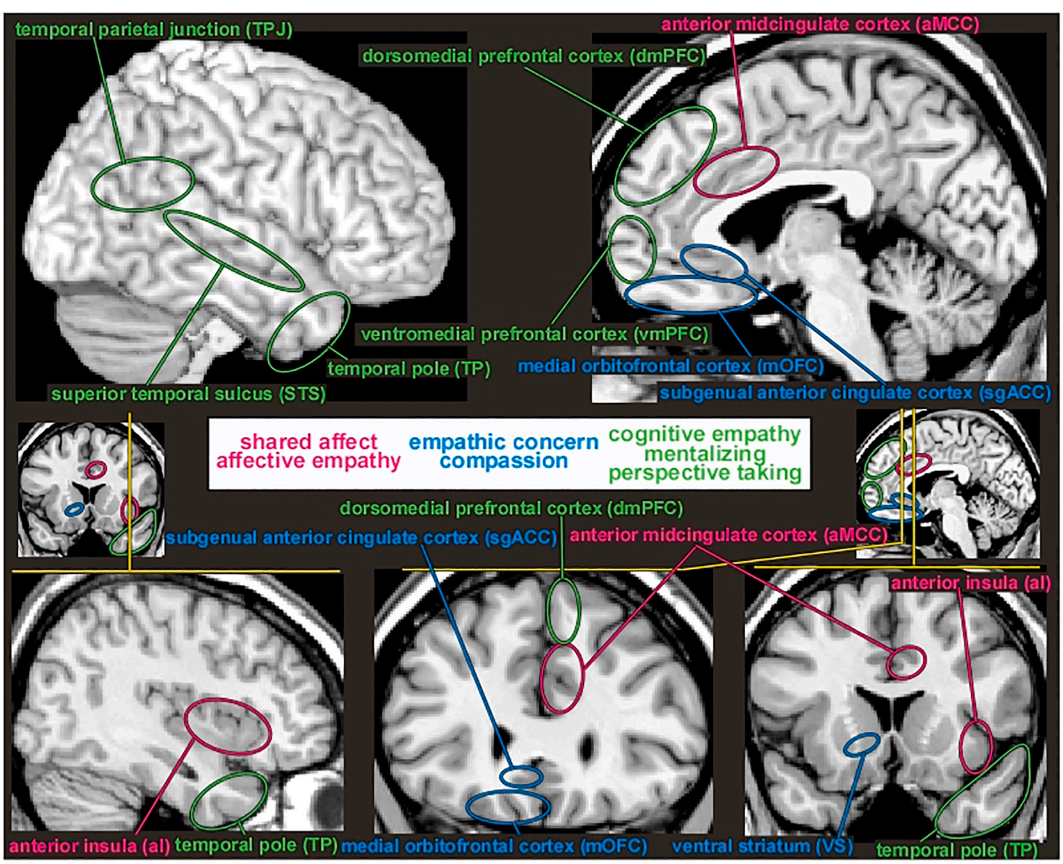


**Fig. 2.** Brain areas associated with affective empathy, cognitive empathy, and compassion.

(Fan et al., 2011; Schnell et al., 2011; Lamm et al., 2011; Völlm et al., 2006) (see Fig. 2). The TPJ which plays an important role in distinguishing between the self and the other (Silani et al., 2013) may be particularly significant in identifying between self-pain versus other pain. The inferior frontal gyrus (IFG) also appears to be important in the recognition of emotional expression that is involved in empathy (Liakakis et al., 2011). Notably, when empathic cues were related to a facial expression such as wincing in pain the IFG showed increased activation relative to other empathy cues such individual's arm in distress (Jauniaux et al., 2019).

This ability to understand the emotional and cognitive state of another through observation also led to the suggestion that mirror neurons might be involved in empathizing (Bastiaansen et al., 2009; Hunter et al., 2013). Although an interesting speculation, the requirement of recording the responses of single neurons in order to demonstrate mirror neuron properties means that there is very little mirror neuron research in humans (Lamm and Majdandžić, 2015). Mirror neurons in premotor and inferior parietal areas respond in a similar manner when an individual executes a goal-directed action and when they observe the same action being executed by another (Hunter et al., 2013), and neuroimaging studies do demonstrate a functional overlap in brain areas when individuals are observing and experiencing the same emotions, but this does not mean that the same neurons are activated by both conditions (Bastiaansen et al., 2009). Correlation evidence does exist supporting the use of mirror neurons in both cognitive and affective empathy (Bekkali et al., 2020), however, these correlations are only moderate. Interestingly, emotional contagion which some consider to be a precursor to affective empathy appears to activate both the IFG and inferior parietal lobe (Shamay-Tsoory, 2011), both areas that have been shown to have mirror neurons in humans (Chong et al., 2008; Kilner et al., 2009), indicating these areas may be important in the recognition of emotions in others, with the IFG particularly important to the recognition of emotional expressions in others as noted above.

## 4. Situational and group factors in the Brain's empathy response

Behavioral research on empathy shows that empathy responses both vary across individuals (Eisenberg et al., 1994) and are situationally influenced (Graziano et al., 2007). The data from neuroimaging research supports these differences too. The aMCC and aI have been shown to play a fundamental role in the expression of affective empathy towards another person's pain, can also be influenced by situational factors, and functional imaging studies support this. When nurses viewed pictures of injured parts of the body both their subjective ratings (pain valence, pain arousal) and areas of the brain activated varied by whether the location was primed as being in a hospital or at home. In the hospital context compared to the home context, pain stimuli elicited lower negative ratings and greater activation in TPJ (Cheng et al., 2017).

The brain's empathy response also varies based upon the individual who is being empathized with. This can vary by trustworthiness, closeness, social status, and group membership of the other. Singer et al. (2006) found when playing an economic game, fair players elicited more empathy than unfair players. This trustworthy effect has been further observed in faces, with trustworthy faces receiving more empathy (Sessa and Meconi, 2015). Observing the social exclusion of a friend was associated with activations in aI and aMCC, whereas observing the social exclusion of a stranger was associated with activations in dmPFC, precuneus, and TP (Meyer et al., 2013). Similar, observing low social status individuals in comparison high-status individuals increasingly activated the aI and aMCC, areas associated with affective empathy (Feng et al., 2016). Multiple studies have shown stronger empathy responses to one's own ethnic or racial group when compared with out-groups (Eres and Molenberghs, 2013). For example, observing injury being inflicted on a same-race hand was associated with greater activation of aI and stronger arousal (pupil dilation) than observing injury to an other-race or a violet hand, although activations in somatic and motor areas were similar (Azevedo et al., 2013). In another study higher activations were found in aMCC/supplementary motor area when subjects viewed in-group member's pain as opposed to out-group member's pain (Xu et al., 2009). This work suggests that individuals may not feel the same level of distress or empathy when seeing an out-group member suffer as compared to an in-group member. Interestingly, through intergroup contact, the brain's empathy response can change. Cao et al. (2015) found Chinese subjects showed an increase in ACC activation in response to viewing Australians in pain after having had increased interracial contact with Australians. This difference in the brain's empathy response exists for many in-group/out-group associations outside of race too, like sports team associations (Cikara et al., 2011; Hein et al., 2010). However, distinguishing between an in-group and out-group member is a matter of context and perception (you are my friend when we are working collaboratively to complete a project, you are my enemy when we are cheering for rival teams), and therefore can be altered (Reihl et al., 2015). Some research indicates that an individual's level implicit racial bias may also magnify the differences in the brain's empathy response between race in-group members and race out-group members (Avenanti et al., 2010). One potential explanation from the variation in the empathy response between in-groups and out-groups may be related to the effects of the neuropeptide oxytocin.

## 5. Oxytocin and empathy

Oxytocin was originally thought to increase empathy amongst all individuals. Yet, closer examination showed that while administration of oxytocin increased empathy for in-group members, it had no effect or actually decreased empathy for out-group members (De Dreu and Kret, 2016). Recently, it has been proposed that oxytocin acts to increase the salience of social stimuli, thus accounting for the varying behavior responses between in-group and out-group members (Ne'eman et al., 2016). Oxytocin does appear to consistently improve the ability to recognize basic emotions (facial affect), although a meta-analysis of studies indicates that this is dependent on both exposure time and valence (shorter exposure times improved recognition of happy and angry, longer exposure times improved recognition of fear) (Shahrestani et al., 2013). Other more nuanced studies on empathy show that oxytocin appears to increase affective empathy while having little or no effect on cognitive empathy (Domes et al., 2019; Geng et al., 2018; Hurleman et al., 2010). Interestingly, oxytocin also appears to increase empathy accuracy for men with an autism personality marked social deficits, and this effect was strongest for those with the highest autistic traits (Bartz et al., 2010a).

It has been proposed that genetic variation in the oxytocin receptor has effects on individual empathy via modulation of dispositional empathy and physiological responding (e.g., autonomic, stress reactivity) (Rodrigues et al., 2009; Smith et al., 2014; Wu et al., 2012). Research finds a correlation between the oxytocin receptor gene and psychopathy traits, suggesting that the oxytocin gene can affect the brain's empathy response (Dadds et al., 2014).

The oxytocin response can be affected through environmental hazards too. Wismer-Fries et al. (2005) found that children who were raised in extremely emotionally neglectful environments had dysregulated oxytocin systems. Indeed, this is consistent with other evidence that insecure attachment disrupts normal oxytocin functioning (Bartz et al., 2010b; Strathearn et al., 2009). Research shows that feeling empathy (watching a father talk about his son with brain cancer) appears to subsequently raise oxytocin levels, and lead to more charitable donations, this effect was also more pronounced for women than men (Barraza and Zak, 2009). Studies have also suggested that oxytocin can be utilized as a treatment tool in developing secure attachments (Buchheim et al., 2009; Weisman et al., 2012). In this regard, oxytocin could also be used in treating psychopathology (Simeon et al., 2011) and in conjunction with psychotherapy (Olff et al., 2010).

Frontotemporal dementia (FTD) does not have one single pathophysiology, it is marked by deficits in cognitive functioning related to the frontal and temporal lobes (Bang et al., 2015; Johen and Bertoux, 2019). Individuals with FTD exhibit decreased empathic concern in comparison to other types of dementia like Alzheimer's Disease (Sturm et al., 2018). This could be related to impaired function in brain areas like IFG and TPJ. As noted earlier, the IFG is important for identifying facial cues of emotional expression, while TPJ is involved in mentalizing and theory of mind. Inability to identify emotions would certainly impair empathy, while mentalizing deficits could be important in making the self/other distinction, which would likely help the individual to move from a state of emotional contagion to empathic concern (Johen and Bertoux, 2019). Oxytocin has been shown to increase IFG activation in patients with FTD (Oliver et al., 2020). However, studies testing the potential of oxytocin for improving social cognition in FTD have been less robust (Tampi et al., 2017). Although it's still unclear how oxytocin improves empathy in patients with FTD, increasing research indicates oxytocin may enhance parasympathetic nervous system response (Carter, 2014; Norman et al., 2011). One study reported that oxytocin modulates parasympathetic activity while perceiving facial cues (Gamer and Buchel, 2012), and reduced baseline parasympathetic activity has been identified in FTD (Sturm et al., 2018). Thus, oxytocin might help to calm one's autonomic nervous system, especially when perceiving uncomfortable emotions, improving the ability to process negative emotions in faces (Tillman et al., 2019).

Since oxytocin has been found to increase empathy, pair bonding, and affiliation amongst in-group over out-groups (De Dreu and Kret, 2016), effects on pro-social behavior may vary by affiliation. Some research indicates that oxytocin may increase pro-social behavior (Barraza and Zak, 2009; Zak et al., 2007). A review of data shows that situational and individual differences greatly moderate the effect of oxytocin on behavior (Bartz et al., 2011). In general, it is still difficult to make any conclusive statements about the role of oxytocin in empathy due to the varying range of behavior responses (Stevens et al., 2013). In summary, oxytocin can facilitate attachment and certain aspects of empathy, yet it does not appear to have a strong direct effect on increasing pro-social behavior. The evidence presented thus far demonstrates that the perception of human suffering does not produce a single common empathy response, and these differences raise an important concern for those interested in the pursuit of human equality and social justice.

## 6. Empathy and pro-social behavior

As noted previously, research indicates that affective empathy (sharing another's feelings) does not necessarily translate to pro-social action (Barlińska et al., 2013; Eisenberg and Miller, 1987; Jordan et al., 2016; Vachon et al., 2014). In fact, it could even have an opposite effect (Decety and Yoder, 2016), and some scholars consider empathy to be detrimental (Bloom, 2017). While other research has shown, affective empathy increases pro-social action (Masten et al., 2011; Williams et al., 2014), and others find minimal effects (Eisenberg and Miller, 1987). How the results of these studies are interpreted is important in understanding the role of affective empathy in pro-social behavior. One theory is that when the level of personal distress in empathizing with someone reaches a given threshold, individuals appear to tend to their own feelings rather than using that distress as a motivation to help others in need (Eisenberg and Fabes, 1990). Lockwood et al. (2017) demonstrate that individuals will help others, but stop once their helping takes on a personal cost. Thus, it has been suggested that an optimal level of affective empathy may be essential for promoting subsequent pro-social behavior. Too little affective empathy and the individual feels no concern, too much and the individual disregards another's suffering to cope with their own emotions (Eisenberg and Fabes, 1990). This has been successfully demonstrated in the rodent population that both low and high levels of negative arousal are detrimental to altruistic behavior (Ben-Ami Bartal et al., 2016). So, while affective empathy may be an important component in motivating individuals to engage in pro-social behavior when too extreme, individuals are likely to disengage from the situation to cope with their own feelings.

Cognitive empathy may be associated with pro-social behavior. Waytz et al. (2012) found pro-social behavior was marked by dmPFC activity, this area is involved in mentalizing, and helps individuals understand the needs of others better thus enabling more altruistic behavior. Engaging in cognitive empathy is a tax on the brain, and research shows individuals avoid high effort cognitive tasks (Kool et al., 2010) Cameron et al. (2019) found across multiple studies that cognitive empathy is exhausting, and individuals prefer not to think and feel about someone in distress, even if a reward is offered. It appears individuals decide whether to invest the cognitive costs of cognitive empathy before moving on to engage in pro-social behavior (see Fig. 1: cost decision).

Pro-social behavior is also associated with positive affect (Batson, 1990). Individuals that experienced greater levels of positive affect while viewing pictures of orphans donated more money for them, and this behavior was predicted by greater activation of the nucleus accumbens (NAcc) (Genevsky et al., 2013; Genevsky and Knutson, 2015). The NAcc and amygdala appear to be uniquely related to pro-social behavior (Haruno et al., 2014; van der Meulen, van IJzendoorn, & Crone, 2016). Activation of the NAcc during a crowdfunding choice task more accurately predicted pro-social giving choices than an individual's own self-report of liking or the predicted usefulness of the gift (Genevsky et al., 2017), suggesting the brain's emotional response is more predictive of pro-social behavior than an individual's own estimate of their behavior. Haruno and Firth (2010) reported that amygdala activation is representative of an aversion to unfairness in altruistic individuals. Further studies of the amygdala and justice involve the ultimatum game, where participants decide to accept or reject a proposer's offer to split a pot of money. If accepted the participant gets the offered money, if rejected neither player receives money. Research shows that amygdala activity is correlated with increased rejection rates of offers. However, administration of a benzodiazepine, which reduces amygdala activity, increased the acceptance rate of offers, indicating greater willingness to accept less than fair offers (Gospic et al., 2011). In the ultimatum game, the optimal strategy for maximum profits is to accept most all offers. The increased amygdala response seems to help participants to recognize injustice but may also make individuals less willing to cooperate, indicating again that regulating emotion to a moderate level could to important in facilitating pro-social behavior.

Emotional regulation is the process of modulating or managing one's emotions to promote well-being and optimal functioning in the environment (Gross, 1999). Eisenberg (2000) believes that emotion regulation may be an important mediating process for turning affective empathy into subsequent pro-social behavior. However, it's important to note that emotional regulation is not one single skill (Gross, 1999) and that different types of emotional regulation could have varying effects on the relationship between empathy and pro-social behavior, wherein some strategies are more effective in maintaining concern for others. Lockwood et al. (2014) demonstrated that the ability to regulate emotion is a significant moderating variable in the relationship between empathy and pro-social behavior; and individuals better at regulating emotion were more likely to engage in pro-social behavior. They also found this effect varied by emotion regulation strategy. Cognitive reappraisal increased pro-social behavior, whereas suppression did not.

Alternatively, Cameron and Payne (2011) offer evidence that emotional regulation may reduce pro-social behavior; demonstrating that individuals regulate their emotions proactively and individuals with strong emotional regulation skills mitigate their affective empathy, which could result in a decrease in pro-social behavior. The authors term this phenomenon as the collapse of compassion, that individuals decrease their affective empathy as a way to protect their own well-being, even if it comes at the expense of losing their compassion for another (Cameron and Payne, 2011). Studies consistently indicate that the larger the number of individuals suffering, the less distress people feel and the less they engage in pro-social behavior (Kogut and Ritov, 2005; Slovic, 2007; Västfjäll et al., 2014). Although emotion regulation is typically considered to be a positive psychological asset (Gross, 2013), it may be that emotional distress reaches a certain threshold, where individuals choose to forgo helping someone else to focus on coping with their own feelings. The Cameron and Payne (2011) study did not evaluate how emotional regulation affected pro-social behavior, only that participants with strong emotional regulation skills were able to decrease their emotional experience, in response to greater victims. It may be too, that those participants low in emotional regulation skills are also just as likely to not engage in pro-social behavior, while at the same time struggling more with greater feelings of personal distress. Cameron and Payne (2011) also did not examine how participants were regulating their emotions either. It has been established that different emotional regulation strategies have different outcomes (Engen and Singer, 2015; Lockwood et al., 2014). It appears self-compassion may be an emotional regulation strategy that both maintains one's emotional well-being while keeping their affective empathy intact.

## 7. Compassion

The etymology of compassion comes from "com" and "pati" meaning together suffering. Singer and Klimecki (2014) see compassion as a feeling of concern accompanied by motivation to help. Goetz, Keltner and Simon-Thomas (2010) define compassion, similarly, seeing compassion as its own unique emotion, separate from affective empathy, similar to sadness, but with a more distinct approach function motivating one towards action (Goetz et al., 2010). While compassion may be an emotional response, it's also adaptable through compassion training. Compassion training, which through quiet concentration fosters feelings of goodwill and friendliness, has been shown to increase one's compassionate response, and this also leads to increased pro-social behavior (Leiberg et al., 2011; Weng et al., 2013). Klimecki et al. (2014) found that empathy resonance training (which increases affective empathy) increased negative affect and activation of the aI and aMCC, when compared to a control memory training group. However, if compassion training was added after empathy resonance training, individuals still experienced increased affective empathy, but they could then also subsequently reduce that negative affect. Compassion training is marked by increased activation of the ventral striatum (VS)/NAcc, subgenual anterior cingulate cortex (sgACC), and medial orbitofrontal cortex (mOFC) (see Fig. 2) (Kim et al., 2009; Klimecki et al., 2014; Singer and Klimecki, 2014), areas involved in reward and pleasure (Kringelbach and Berridge, 2009; Taber et al., 2012). Other work has shown that these reward areas are involved in pro-social behavior as well (Genevsky et al., 2013; Genevsky and Knutson, 2015). The Klimecki et al. (2014) study demonstrates that individuals can experience negative affect associated with affective empathy and then through practicing compassion mitigate the negative emotional response. In fact, Lim and DeSteno (2016) show that empathy may lead to compassion, but it is compassion that influences whether someone engages in a pro-social response or not. Compassion training appears to allow someone to experience affective empathy without becoming so distressed that they disengage in their feelings for another individual, resulting in a state of empathic concern as opposed to personal distress. Imaging studies show empathic concern overlaps with many of the same brain areas that have been identified with compassion, like the mOFC, sgACC, and areas of the VS like the NAcc (see Fig. 2) (Ashar et al., 2017; FeldmanHall et al., 2015; Zahn et al., 2009). While personal distress appears to activate the motor and somatosensory areas (Ashar et al., 2017), indicating that personal distress and empathic concern are very different responses to experience sharing or affective empathy. Work shows that this response of empathic concern/compassion, not personal distress, helps accurately recognize emotion (Israelashvili et al., 2020) and increases pro-social behavior (FeldmanHall et al., 2015; Williams, O'Driscoll and Moore, 2014). Researchers have suggested that compassion training may help to increase pro-social behavior by offering an alternative means of emotional regulation, where one can tolerate experiencing negative affect by increased positive affect (Kemeny et al., 2012; Lutz et al., 2008). Compassion training has been shown to increase positive affect and lower negative affect when seeing individuals in distress (Klimecki et al., 2013; Klimecki et al., 2014), but it would also be interesting to see if compassion affects the self/other distinction or if it lowers global arousal levels to suffering. Compassion may be the emotional regulation strategy that determines whether one can move from a state of personal distress, which is associated with sub-optimal emotional regulation skills (Eisenberg et al., 1998), to a state of empathic concern. It also appears that the use of compassion as an emotional regulation strategy may be more effective than other emotional regulation strategies in its ability to increase reward and positive affect when utilized (Engen and Singer, 2015). Recent research increasingly shows that compassion training can prevent burnout in caregiving professions where professionals may experience high levels of distress from seeing patients in need (Beaumont et al., 2016; Finlay-Jones et al., 2015; Olson et al., 2015). Additionally, Decety (2020) believes that compassion or empathic concern is the most important aspect of empathy to develop in health care professionals. Other work by Yun et al. (2018) indicates an empathy training program that focuses on building mindfulness and emotional regulation skills may increase empathic communication between physicians and their patients.

## 8. Combining compassion, affective empathy, and cognitive empathy

Multiple researchers have broken the general term of empathy down into three parts. Decety and Jackson (2004) described empathy as having (1) an emotional component which consists of affective sharing, (2) a cognitive component, involving understanding another's perspective, and (3) awareness between self and the other. Ochsner (2013) breaks empathy down into "first, the tendency to take on or share the feelings of others; second the ability to cognitively understand those feelings; and third the tendency to act pro-socially based on those feelings." Weisz and Zaki (2018) also examine empathy motivation in pro-social behavior and identify three similar processes as (1) experience sharing (affective empathy) which involves the aMCC and aI; (2) mentalizing (cognitive empathy) involving mPFC, TPJ, and TP; (3) empathic concern (compassion) involving VS, VTA, mOFC, and NAcc. All researchers seem to agree upon the cognitive and affective empathy components, but the third component is less clear, it seems to involve the ability to engage in pro-social behavior perhaps through compassion as a way to distinguish between the self and other's emotions. However, this process of translating affective empathy to pro-social behavior becomes clearer when examining the primate literature and pro-social behavior. de Waal and Preston (2017) find in their research on altruism with primates. (1) First, there is the emotional transfer of feeling of distress from the primary animal to a second animal, (2) then that second animal emotionally regulates that emotion and consoles the primary animal, (3) which results in reduced distress for the primary animal and an intrinsic reward of altruism for the second animal (de Waal and Preston, 2017). The process in humans is likely no different. There is little support for the basic assumption that empathy alone in the traditional sense directly leads to pro-social behavior (Decety and Yoder, 2016). However, when combining affective empathy with compassion, compassion acts as a mechanism of emotional regulation, which enables the empathizer to manage their own feelings to then successfully care for someone in distress. These three separate processes of affective empathy, cognitive empathy, and compassion in conjunction may provide the optimal conditions for pro-social action. It may be that a minimal level of affective empathy is needed to acknowledge another's suffering and motivate one towards action. Ben-Ami Bartal et al. (2016) finds that rodents treated with an anxiolytic (a drug to reduce anxiety) reduced altruistic behavior, indicating that some emotion needs to be present to motivate helping behavior. Second, compassion training could act as an effective means of individual emotion regulation so one can provide help without becoming emotionally overwhelmed or experience personal distress. Decety and Jackson (2004) believe it is emotional regulation that manages the subjective distinction between the self and other, allowing experiencing sharing to move from personal distress to empathic concern. While lastly, cognitive empathy allows one to understand the cause of the suffering in order to properly direct the pro-social action (see Fig. 1). In summary, all three of these brain processes appear to be necessary for pro-social action to alleviate the cause of another's suffering. Further support for this model (See Fig. 1) comes from an electrical neuroimaging study, researchers found that successful empathy follows a sequential process switching from self-focused to second-person brain regions (Thirioux et al., 2014).

Generalizations against empathy (Bloom, 2017) or for empathy (Hall and Leary, 2020) miss the larger challenges in trying to foster pro-social behavior. Affective empathy for others is important, but how we individually respond to our emotions may be paramount for continued altruism and the prevention of burnout in caregiving professions. This research highlights the need for continued education and practice of self-compassion. Multiple studies have found self-compassion to positively affect well-being (Zessin et al., 2015) and to have an inverse relationship with psychopathology (MacBeth and Gumley, 2012). Affective neuroscience now offers new insights for researchers to distinguish the amongst various brain mechanisms involved in empathy and the capacity for pro-social behavior. By identifying these separate mechanisms researchers can discover where interventions can be utilized to create more pro-social environments for the collective and individual good.

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