Characterising the relationship between empathy and emotion regulation

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Declaration of original authorship

I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged.

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Abstract

Empathy and emotion regulation are both processes that are vital for effective social functioning and emotional wellbeing. Broadly speaking, empathy refers to understanding and/or sharing another's emotion, and emotion regulation refers to the processes by which one manages emotions. Despite increasing awareness that empathy and emotion regulation may be closely related, there has been little empirical study of this topic and the nature of the inter-relationships between their different component processes are not well characterised.

This thesis addresses current gaps in the literature by utilising a range of approaches, including self-report, behavioural, eye-tracking, and psychophysiology measures, to examine the relationship between different trait and task measures of empathy and emotion regulation. It was predicted that the cognitive (i.e. understanding others' emotions) and affective (i.e. sharing others' emotions) dimensions of empathy would show different relationships with emotion regulation. Broadly speaking, it was expected that emotion regulation abilities would be positively associated with cognitive empathy but negatively associated with affective empathy.

There was strong support for the hypothesis that empathy and emotion regulation are related. Furthermore, in most studies there was evidence to suggest that cognitive and affective empathy are related to emotion regulation abilities and behaviours in different ways. Divergent

relationships between trait and task metrics of cognitive and affective empathy were observed for various emotion regulation measures, including habitual strategy use, implicit emotion regulation ability, and reappraisal ability. While there was some support for the hypothesis that emotion regulation abilities are positively associated with cognitive empathy but negatively associated with affective empathy, conflicting findings were observed.

This thesis makes a significant contribution to current knowledge and represents an important step towards elucidating the nature of the relationship between empathy and emotion regulation. The findings also highlight some important considerations regarding the relationship between different methods used to assess empathy and emotion regulation, and prompt actionable research questions to be addressed by future work.

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List of manuscripts resulting from this thesis

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Chapter 1

Introduction

1.1. General introduction

Empathy and emotion regulation are both processes that are vital for effective social functioning and emotional wellbeing (Decety and Lamm, 2006; Gross, 2002, 2015). Broadly speaking, empathy refers to understanding and/or sharing another's emotion (Chakrabarti and Baron-Cohen, 2006; Decety and Jackson 2004; Preston and de Waal 2002), and emotion regulation refers to the processes by which one manages emotions (Gross, 1998, 2015). While empathy and emotion regulation largely have been considered separately, there is growing awareness that these processes may be closely related. Consider a situation in which somebody has upset or angered you. Trying to see things from that person's perspective and understand the motivations behind their actions can often help to regulate any negative emotions you felt as a result of their behaviours. Or think of a parent whose child is in pain. Empathic processes can allow the parent to understand and share their child's distress. However, if they are unable to sufficiently regulate the emotional state elicited via empathic processes, it could impede the parent's ability to support their child appropriately. These everyday examples illustrate just some of the ways in which empathic and regulatory processes may interact.

While the extant literature discussed in this chapter provides some evidence to suggest that these constructs may be related, there has been little systematic study of this topic. As such, the nature of the inter-relationships between different component processes related to empathy and emotion regulation are not well characterised. The research presented in this thesis addresses current gaps in the literature by utilising a range of approaches, including self-report, behavioural, eye-tracking, and psychophysiology measures, to examine the relationship between the various component processes that comprise empathy and emotion regulation. This introductory chapter discusses key background literature relevant to the studies described within. I begin with an overview of the key components of empathy and emotion regulation, before discussing existing theoretical and empirical work suggestive of a relationship between these two constructs.

1.2. Empathy

Empathy refers to the capacity to understand and/or share the emotions of others. These abilities serve vital social functions, such as enabling one to understand and respond appropriately to others, thereby supporting the development and maintenance of interpersonal relationships (Bailey et al., 2008). Levels of empathy have been shown to vary within the general population, and it is considered to be a measurable and relatively stable trait (Baron-Cohen and Wheelwright, 2004; Leiberg and Anders, 2006). Various approaches have been used to assess variability in empathy; subsequent chapters describe in greater detail some commonly used self-report (chapter 2) and task-based (chapter 3) measures of empathy. The focus of this section is upon providing a broad overview of the construct, highlighting the different component processes that support the human capacity to understand and resonate with the emotional experiences of others.

1.2.1. Component processes of empathy

Most theories of empathy distinguish between two core dimensions: affective empathy (the propensity/ability to *share* others' emotions), and cognitive empathy (the ability to *understand* others' emotional experiences) (Decety and Jackson, 2004; Singer and Lamm, 2009). There is considerable support for this distinction between the cognitive and affective dimensions of empathy, which are each mediated by largely non-overlapping neural substrates (see review by Yu and Chou, 2018). For example, individuals with autism spectrum conditions (ASC) exhibit deficits in understanding others' emotional states, but their ability to resonate with others' emotions remains relatively intact (Baron-Cohen and Wheelwright, 2004; Lockwood et al., 2013; see Frith and Happé, 2005, for review). Conversely, individuals with psychopathic traits and conduct disorder display deficits in the affective dimension of empathy, but do not show similar difficulties with cognitive empathic abilities (Jones et al., 2010; Lockwood et al., 2013; Sebastian et al., 2012).

While many theoretical accounts use the term empathy to refer to the end-state(s) associated with understanding and/or sharing another's emotion, I propose that empathy is best conceptualized not as end-states, but as the processes themselves that mediate these states. As such, empathy is not a distinct emotional state per se (e.g. sadness, happiness), but rather a set of processes through which these emotion-states can be cognitively represented and/or generated in response to observing another conspecific. The rationale for a departure from the conventional framing of the term empathy as an emotional state is that such use of the term can conflate it with other experiences, such as sympathy, which represents just one possible outcome of observing another individual's emotional state (Batson et al., 1987; Eisenberg et al., 1989).

In this thesis, I use the following heuristic for empathy, with three core components: 1) perception (perceptual mechanisms that facilitate the detection of relevant emotion cues), 2) mimicry/embodiment (mechanisms that can elicit spontaneous resonance with another's emotions), and 3) cognitive processes (mechanisms that enable the observer to make inferences about another's experience and manage the co-active self and other related representations) (fig. 1.1).

These empathic components reflect separable mechanisms mediated by distinct neural networks, each of which contributes to the understanding or sharing of another individual's emotional response as it unfolds. An affective reaction to another's emotional state has the potential to be elicited in response to whatever cues are available to the perception of the observer. Importantly, different emotion cues may act upon the observer in different ways. When "concrete" cues such as facial, bodily, or vocal expressions can be perceived, the empathic process can be mediated by mimicry/embodiment mechanisms, which may result in sharing of emotion. In the absence of any concrete emotion cues, “abstract” cues, such as contextual information or verbal mediation through language, can enable an understanding of another’s emotion via inferential cognitive processing (Goldman, 2011). As many situations offer a mixture of both types of cues, many empathy-induced reactions arise from a dynamic interplay between cognitive and mimicry-related processes. In the remainder of this subsection I discuss evidence in support of the delineation between the components of empathy described in this heuristic and draw upon relevant empirical findings to demonstrate the role these processes play in the ability to understand and/or share another’s emotion.

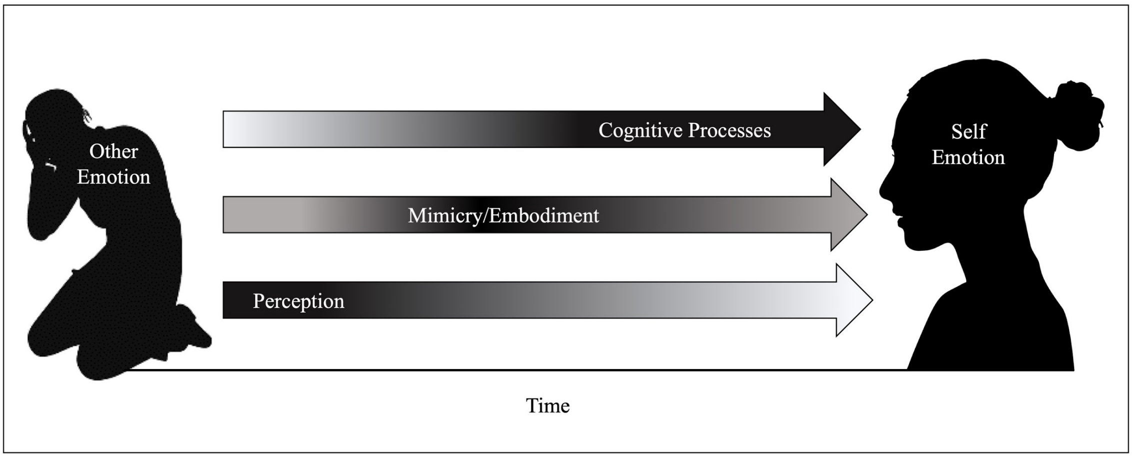

Fig. 1.1. Component processes of empathy: Perceptual processes facilitate the detection of relevant emotion cues; mimicry/embodiment mechanisms can elicit spontaneous resonance with another’s emotions; cognitive processes enable the observer to make inferences about the other’s emotional state and distinguish self from other. The colour grading on each component reflects the temporal gradient of these processes: for example, perceptual processes are active very early in response to a stimulus, whereas cognitive processes come online at a later stage. While the three component processes reflect separable mechanisms that operate on different timescales and can act independently, they often operate in parallel.

1.2.1.1. Perception

Crucial to understanding and responding to another's emotion is the ability to attend to relevant cues pertaining to their state. Thus, attention to socio-emotional stimuli reflects a fundamental precursor to empathic processes. One of the primary means by which human emotion is communicated is through facial expressions (Adolphs, 2002). A human face expressing an emotion represents a highly salient cue that is often processed in a prioritized manner.

Efficient detection of facial expressions of emotion has been demonstrated using various paradigms (e.g. Fox et al., 2000; Sweeny et al., 2012). In attentional blink tasks, the inability to detect a second target face when it is preceded by another target with a short stimulus onset asynchrony (within 200-400ms; Fox et al., 2005) is reduced when the second face is emotional (Yerys et al., 2013). Event related potential (ERP) studies have demonstrated that relative to neutral faces, emotional faces are associated with enhanced positivity of fronto-central components, with differences observed as early as 180 ms after stimulus onset (Eimer and Holmes, 2007). Such findings suggest that salient emotional information may be processed at an early stage of perception on a relatively implicit level.

The importance of perceptual processes for empathy is evident in studies of trait empathy. Studies using the aforementioned attentional blink paradigms have shown that improved detection of sad facial expressions during the ‘attentional blink period’ is positively related to trait empathy (Kang et al., 2017). Further, two recent eye-tracking studies have shown that trait empathy is positively associated with gaze bias towards social versus non-social stimuli (Chakrabarti et al., 2017; Hedger et al., 2018).

Higher trait empathy is also associated with more fixations on the eye-region during face perception (Cowan et al., 2014) and a greater ability to infer complex mental/emotional states from images of just the eye-region (Vellante et al., 2013). The eyes appear to hold a special status in human social perception (Darwin, 1872) and attention to the eye-region of the face plays an important role in the perception component of empathy (Baron-Cohen et al., 1997). This view is supported by findings that individuals with ASC, a group of disorders characterized by deficits in social functioning and understanding others’ mental/emotional states (Baron-Cohen et al., 1985; Frith and Happe, 2005), fixate less on the eye-region when viewing social stimuli than typical controls (Klin et al., 2002).

As the research discussed above highlights, the perception of facial cues pertaining to another’s emotion is a core component process of empathy. While I have focused specifically upon facial expression of emotion, another’s emotions can be communicated in a variety of ways, such as through bodily posture, prosody, or verbal mediation through language (Coulson, 2004; Scherer, 2003; Wallbott, 1998). All emotion cues are not necessarily as concrete as facial and bodily expressions: we routinely have to respond to abstract emotion-relevant cues from our environment. As I will go on to discuss, while concrete emotion cues can spontaneously elicit a response in the observer through mimicry/embodiment mechanisms, abstract cues may require more elaborate cognitive processing (Bird and Viding, 2014; Goldman, 2011).

1.2.1.2. Mimicry/embodiment

Humans display an inherent predisposition to spontaneously mimic the behaviours of others, including their facial expressions, body language, and vocalisations (Chartrand and Bargh, 1999; Chartrand and Dalton, 2008; Dimberg et al., 2000; Hess and Blairy, 2001; Niedenthal et al., 2001). Spontaneous facial mimicry (SFM) has been extensively studied using facial electromyography (fEMG). Perception of emotional facial expressions elicits activity in congruent muscle groups in the observer; e.g. Corrugator supercilii in response to angry faces and the Zygomaticus major in response to happy faces (Dimberg and Petterson, 2000; Dimberg and Thunberg, 1998; Rymarczyk et al., 2018; Sims et al., 2012). Crucially, SFM can be triggered rapidly and automatically (Dimberg and Thunberg, 1998), even when the observer is not consciously aware of the presence of the face (Bornemann et al., 2012; Dimberg et al., 2000). Evidence of such spontaneous mimicry in young children who have not yet developed efficient cognitive control mechanisms (Nadel, 2002), suggests that these processes are recruited early in the hierarchy of empathy-related responses.

Spontaneous mimicry is consistent with the common neural coding between perception and action (Prinz, 1997), whereby the perception of a behaviour automatically activates the motor representations that participate in the first-hand enactment of that behaviour (Dijksterhuis and Bargh, 2001; Preston and de Waal, 2002). This principle has been associated with the putative mirror neuron system (MNS), a network of brain regions activated by both the observation and execution of a given action. The MNS includes the inferior frontal gyrus (IFG), inferior parietal lobule (IPL), superior/middle temporal sulcus/gyrus (STS/MTG), and the anterior insula (AI) (Casile et al., 2011; Iacoboni et al., 1999; Iacoboni and Dapretto, 2006; Rizzolatti and Craighero, 2004). It is thought that the MNS maps the perceived behaviour onto the observer's own motor and affective systems (Bernhardt and Singer, 2012; Stevens et al., 2000).

In the context of others' emotional displays, the shared neural substrates between self and other can evoke in the observer an affective state isomorphic to that of the perceived other (de Waal and Preston, 2017; Hatfield et al., 1993). This set of processes thus potentially enable a quick route to sharing another individual's emotion. This rudimentary embodiment of another's emotion may also facilitate recognition/understanding of the other's state by enabling the observer to draw upon the experience of the other mirrored in his or her own brain and body (Adolphs, 2002; Bastiaansen et al., 2009; Carr et al., 2003; Chartrand

and Bargh, 1999; Dimberg et al., 2000; Hatfield et al., 1993; Niedenthal et al., 2001; Preston and de Waal, 2002).

In support of the role of mimicry/embodiment in empathy, the magnitude of SFM has been found to be positively related to the extent of self-reported emotion shared between the observer and observed other (Sato et al., 2013, though see Hess and Blairy, 2001), and also to trait measures of empathy (Dimberg et al., 2011; Sonnby-Borgstrom, 2002). Similarly, activation of structures in the MNS has been noted consistently across a range of paradigms measuring empathic processes (Carr et al., 2003; Chakrabarti et al., 2006; Kaplan and Iacoboni, 2006; Lamm et al., 2011). Individual differences in MNS activation have also been related to trait empathy. For instance, IFG activity during the perception of emotional faces and bodily movements is positively correlated with trait empathy (Kaplan and Iacoboni, 2006; Pfeifer et al., 2008). Meanwhile, lesions in MNS regions are associated with deficits in emotion recognition and a reduced capacity to share others' emotions (Adolphs et al., 2000; Shamay-Tsoory et al., 2009).

In sum, mimicry/embodiment represent component processes within empathy that enable a direct mapping of another individual's emotion on to the motor and affective systems of the observer, without an explicit need for complex cognition. These processes occur at an early stage of stimulus decoding and are largely automatic in nature. Further, mimicry/embodiment processes may often, although not always, interact with the cognitive processes of empathy described in the following subsection.

1.2.1.3. Cognitive processes

The cognitive processes within empathy have been given various labels, such as perspective-taking and mentalizing, and are often considered synonymous with the construct of theory of mind (ToM) (Batson, 2009; Frith and Frith, 2003; Premack and Woodruff, 1978). This cognitive component encompasses various processes that enable the observer to take the perspective of another individual and make inferences about their mental/emotional state, based on knowledge of the context and estimations of the other's beliefs/intentions (Frith and Frith, 2003). When concrete emotion cues are available, cognitive processes often interact with mimicry/embodiment processes. In the absence of concrete emotion cues, this cognitive-inferential route may in itself be sufficient to enable an understanding of, and affective response to, another's emotion (Goldman, 2011; Singer and Lamm, 2009; Walter, 2012).

Emotional responses to a given stimulus/situation depend on how it is appraised in relation to one's goals (Buhle et al., 2014; Moors, 2013). Thus, in order to accurately represent and respond to another's emotions, the observer must make inferences about the knowledge, goals, and appraisals of the other in a given situation (Frith and Frith, 2003, 2006). At the most basic level, such inferences can be drawn from situational cues using simple social scripts. For example, knowing that a student has missed the school bus may enable an observer to infer that he or she is likely feeling anxious about being late to school. Critically, the accuracy of these inferential processes is dependent upon the knowledge of the observer (Bird and Viding, 2014; Goldman, 2011). One who is not familiar with school buses and the education system might find it difficult to make the inference relative to another who is more embedded within this socio-cultural milieu.

Empathic processes can often lead to co-active representations of self and other (Decety and Sommerville, 2003; Osborn and Derbyshire, 2010; Santiesteban et al., 2012). In attempting to represent another's state via inferential processes, failures in self other-control can result in egocentric interference, whereby the observer's own knowledge, beliefs, and states can affect how accurately he or she is able to infer another's state (Camerer et al., 1989; Derbyshire et al., 2013; Epley et al., 2004; O'Connell et al., 2015; Silani et al., 2013; Todd et al., 2015). Similarly, where spontaneous mimicry/embodiment of another's emotion is elicited by concrete emotion cues, self-other control processes are necessary for the observer to subsequently represent the other's emotion as distinct from his or her own (Decety and Chaminade, 2003; Preckel et al., 2018). Thus, maintaining self-other distinction is an important cognitive process within empathy, that enables an understanding of another's emotion state (Jackson et al., 2005; Lamm et al., 2007).

In contrast to the relatively automatic nature of mimicry/embodiment processes, this cognitive component reflects more effortful processing. It relies upon various facets of cognitive control (Carlson et al., 2004; Dennis et al., 2009; Gokcen et al., 2016; Hansen, 2011) which enable the observer to simultaneously represent their own and the other's state, inhibit their default egocentric perspective in order to take the perspective of the other, and draw upon relevant knowledge from stored memory (Bird and Viding, 2014; Chakrabarti and Baron-Cohen, 2006; Goldman, 2011; O'Connell et al., 2015).

The cognitive component of empathy is associated with a largely cortical network including the medial prefrontal cortex (mPFC), the temporoparietal junction (TPJ), the superior temporal sulcus (STS), and the anterior temporal pole (TP) (Frith and Frith, 2006; Ruby and Decety, 2004; Saxe et al., 2004; van Overwalle and Baetens, 2009), with activations in these regions reported across a range of tasks that involve inferring another's mental/emotional state (Atique et al., 2011; Corradi-Dell'Acqua et al., 2014; Goel et al., 1995; Lamm et al., 2011; Morelli et al., 2014; van Overwalle, 2009).

In sum, cognitive processes represent the most elaborate and complex set of empathic processes. They involve switching between the representations of self and other in service of inferences based on concrete and/or abstract cues that requires the integration of perceptual information with stored knowledge. Understandably, these cognitive processes necessitate more cortical resources and time, and as such, occur later and evolve over a longer timescale than the other empathic processes described above.

1.3. Emotion regulation

Emotion regulation comprises diverse processes that transform a goal to experience a different state into distinct strategies that attempt to bias the unfolding of emotion in the desired direction (Gross, 1998, 2015). Emotions are typically defined as psychological and somatic responses to motivationally significant events (Frijda, 1986; Levenson, 1999). While emotions can serve a vital and adaptive function, such as facilitating appropriate behavioural adjustments to one's environment (Lazarus, 1991; Levenson, 1999; Oatley and Jenkins, 1992; Tooby and Cosmides, 1990), sometimes the emotions one experiences can be decidedly unhelpful. For instance, in preparing for an upcoming public talk, a moderate level of anxiety may facilitate the motivation necessary to work hard in order to deliver a successful presentation. However, if one's level of anxiety is excessive and/or improperly managed, it can impede the ability to function effectively in pursuit of this goal (Gross, 2015; Tamir and Millgram, 2017).

Emotion regulation enables control of the type, intensity, and duration of emotional experiences (Gross and Thompson, 2007), facilitating the ability to respond flexibly to situational demands and manage one's emotions in such a way that they do not impede successful goal pursuit (Gyurak et al., 2011). The capacity to regulate emotions in an adaptive manner has important implications for social functioning, emotional wellbeing, and physical health (Aldao and Nolen-Hoeksema, 2010; Boden et al., 2013; D'Avanzato et al., 2013; Dvorak et al. 2014; Gross, 2002; Gross and John, 2003). Furthermore, there is evidence to suggest that emotion dysregulation plays a significant role in various psychopathologies, such as depression and anxiety (Crowell, et al., 2014; Folk et al. 2014).

1.3.1. Emotion regulation strategies

A fundamental aim of prior research has been to develop a taxonomic system that explains the myriad ways in which emotions can be regulated (Gross, 1998; Koole, 2009; Larsen, 2000; Naragon-Gainey et al., 2017; Webb et al., 2012a). Various models of emotion regulation have been proposed: Some distinguish between implicit and explicit regulatory processes (e.g. Gyurak et al., 2011), others provide a distinction based on the motivational-functional dimensions of different emotional processes (e.g. Koole, et al., 2006). In order to highlight the various regulatory strategies by which one can manage their emotions, here I refer to the extended process model of emotion regulation (EPM; Gross, 2015).

The EPM suggests that in order to understand how emotions can be regulated, it is useful to consider how emotions are generated in the first place. According to the EPM, emotion generation is a cybernetic process in which a situation in the world, once perceived, is evaluated during appraisal processes, leading to various changes in emotional response systems such as facial expressions, autonomic activity, and subjective feelings (fig. 1.2). Emotion regulation begins when a goal to experience a different emotion is activated by a discrepancy between a generated emotion and some desired emotion state. While regulation goals are often hedonic in a proximate sense (e.g. increase immediate pleasure/reduce immediate pain), they can also be considered hedonic in a more ultimate sense (e.g. facilitate relationships with others) (Tamir, 2016; Tamir et al., 2019).

A regulation goal often leads to the selection and implementation of a regulation strategy to attain the desired state. Emotion regulation strategies can broadly be categorized based on which stage of emotion generation they primarily intervene: world, perception, valuation, or response (Gross, 2015). For instance, consider a situation in which one is feeling anxious about an upcoming presentation. To regulate this emotion by intervening in emotion generation at the world stage, one could cancel the upcoming talk (situation selection) or engage in thorough preparation to reduce feelings of anxiety (situation modification). Alternatively, one could intervene at the perception stage by taking one's mind off the situation (attentional deployment). Another option would be to intervene at the valuation stage and change one's appraisals of the situation, for instance by telling oneself that everything will most likely go according to plan, and even in the worst-case scenario, delivering a bad talk would not be the end of the world (cognitive change). Finally, one could attempt to alter one's actual responses, for example, by attempting to suppress the associated experience/expression of emotion or engaging in deep-breathing to attenuate one's physiological arousal (response modulation).

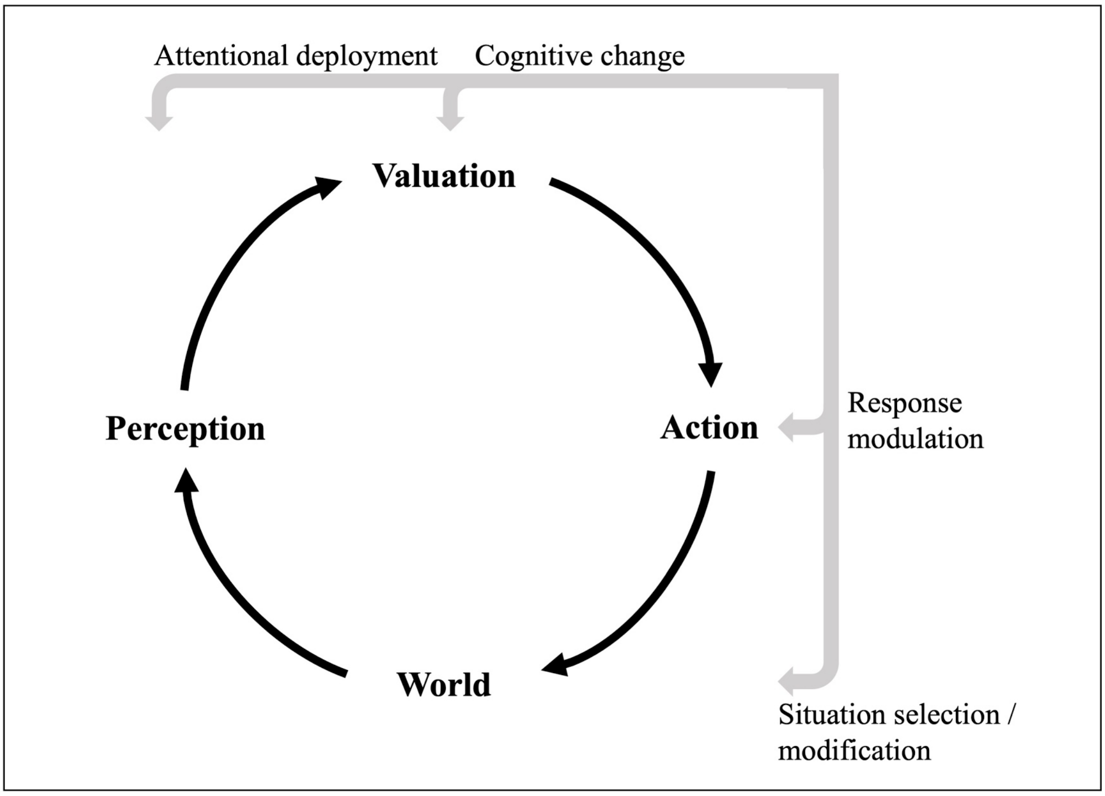

Fig. 1.2. Schematic of the Extended Process Model of emotion regulation (Gross, 2015). The emotion generation process comprises a situation (world), which once perceived (perception) is subject to evaluative processes (valuation) which determine the emotional response (action). Each stage in this cycle can be targeted by different regulation strategies, thereby altering the emotional response the situation elicits.

While there is some variability in the precise network of brain regions associated with different regulatory strategies, emotion regulation has broadly been shown to involve the recruitment of prefrontal and parietal control regions, which attenuate activity in subcortical structures associated with emotion generation (Banks et al., 2007; Ferri et al., 2013;

Goldin et al., 2008; Kalisch, 2009; Urry et al., 2009; Wager et al., 2008). I now discuss in greater detail each strategy described by the EPM, highlighting evidence regarding the underlying processes and neural substrates by which they are mediated, and the typical outcomes they entail. As situation selection/modification strategies are difficult to examine using lab-based approaches, these strategies are not discussed further.

Attentional deployment refers to controlling the way in which attention is allocated to different features of a stimulus/situation in order to alter its emotional impact. This could entail distraction, which involves directing attention away from the emotion-eliciting stimulus in an external (e.g. looking away) or internal (e.g. thinking about something incongruent with the emotional stimulus) manner. In addition to entirely distracting oneself, one may also attend to less emotionally relevant aspects of the situation (Gross and Thompson, 2007; Gross, 1998, 2015). Evidence suggests that people often try to shift their attention away from distressing stimuli (Langens and Morth, 2003), and show different patterns of gaze fixation during regulation relative to control conditions in laboratory tasks (van Reekum et al., 2007). Critically, there is evidence that diverting attention toward non-emotional features is effective in downregulating emotional intensity (Ferri et al., 2013; Nix et al., 1995). Conversely, one's emotional response may be heightened when more emotional features are attended (Ochsner et al., 2004a).

Cognitive change strategies involve modifying the way in which one thinks about the emotion-eliciting stimulus, such that the emotional response it elicits is altered in the desired manner (Gross, 1998, 2002, 2015). The most commonly studied cognitive change strategy is reappraisal, which is often operationalized either as semantic reappraisal or reappraisal via perspective taking (Webb et al., 2012a). Semantic reappraisal refers to a cognitive-linguistic strategy in which the meaning adhered to an emotional stimulus is altered (Goldin et al., 2008; Hajcak and Nieuwenhuis, 2006; Phan et al., 2005). Reappraisal via perspective taking involves adopting the perspective of a detached observer in order to cognitively distance oneself from an emotional stimulus/state, without necessarily changing its meaning (Erk et al., 2010; Koenigsberg et al., 2010; Messina et al., 2015; Webb et al., 2012a).

When participants are instructed to use these forms of reappraisal in laboratory studies, they experience significant reductions in negative emotional experience based on self-report, psychophysiological, and neural measures (Harrison and Chassey, 2019; Jackson et al., 2000; Ray et al., 2010; Shiota and Levenson, 2012; Wallace-Hadrill and Kamboj, 2016; Webb et al., 2012a). Furthermore, the habitual use of reappraisal is associated with various favourable outcomes, such as increased trait positive affect, more effective interpersonal functioning, and increased emotional well-being (Gross, 2002; Gross and John, 2003).

Response modulation strategies act directly upon the emotional response itself. The most commonly studied form of response modulation is expressive suppression (henceforth suppression), which involves efforts to inhibit behaviours associated with the expression of emotion (e.g., facial expressions) (Gross, 1998, 2015). Suppression is broadly considered to be a maladaptive emotion regulation strategy, with evidence that it is associated with increased sympathetic/cardiovascular activity (Gross and Levenson, 1997), increased acoustic startle response (Hagemann et al., 2006), and sustained activations in the amygdala and insula (Goldin et al., 2008). While some studies have found evidence of reduced self-reported negative emotion during suppression, this could be due to the redirection of attention necessary to control one's facial muscles, which may inherently reduce attentional resources allocated to the emotional stimulus/experience (Goldin et al., 2008).

In sum, emotion regulation comprises various strategies that enable the individual to manage their emotional responses by targeting different stages of the emotion generation process. As highlighted above, different regulation strategies vary in their short-term efficacy in modulating emotion; importantly, they may also differ in terms of their longer-term consequences (Gross, 1998, 2002, 2015; Koole, 2009; Tamir, 2009, 2011). Consider again the example of feeling anxious about an upcoming presentation. Efforts to distract oneself from the situation (i.e. attentional deployment) may reduce feelings of anxiety in the short-term, but at the expense of long-term emotional adaptation (Kross and Ayduk, 2008; Paul et al., 2016; Uusberg et al., 2016). While trying to think differently about the situation (i.e. reappraisal) may be somewhat less effective than distraction in its short-term influence on the emotion state, this strategy may facilitate long-term adaptation, enabling the individual to more effectively deal with the affective impact of similar situations in the future (MacNamara et al., 2011).

While the primary focus of the EPM is upon the different regulatory strategies by which one can control their emotions, the model also highlights a broader repertoire of abilities necessary for effective emotion regulation. In addition to one's capacity to implement a given regulatory strategy, effective emotion regulation is reliant upon the ability to be aware of one's emotions and to select a regulatory strategy appropriate to a given emotional experience and context (Gross, 2015; Sheppes et al., 2015). This assertion is broadly aligned with other models of emotion regulation, which suggest that to adequately capture the complexity of the construct, one should take into account a range of abilities, such as: 1) awareness/clarity regarding one's emotional experiences, 2) the capacity to select and implement appropriate regulation strategies to manage emotions across diverse contexts, and 3) the ability to monitor the extent to which regulatory efforts are successful in generating the desired modulation of emotion (Bonanno and Burton, 2013; Gratz and Roemer, 2004; Koole et al., 2015).

1.3.2. Explicit and implicit emotion regulation

A further distinction between different regulatory processes is the extent to which they are reliant upon conscious effortful implementation. Dual process models are common within human psychology and typically distinguish between *implicit* and *explicit* processes (Bargh and Gollwitzer, 1994). With regards to emotion regulation, explicit refers to the modulation of emotion by processes reliant upon conscious effortful implementation and monitoring; implicit refers to processes that are enacted in a relatively automatic manner and can exert their modulatory effect on emotion without the need for effortful cognition or conscious awareness (DeWall et al., 2011; Gyurak et al., 2011; Mauss et al., 2007).

As most definitions of emotion regulation emphasise "control" over one's emotional experience, it is relatively unsurprising that the term is most commonly used to refer to more deliberate effortful processes. Indeed, many processes associated with emotion regulation are closely aligned with this definition and involve conscious and deliberate efforts to control the frequency, intensity, and type of emotion (Gross, 1998, 2015). However, given the frequent need for emotion regulation in day-to-day life, the effortful nature of more explicit regulatory processes can place significant demands on vital and limited cognitive resources; thus, their implementation may not always be possible. Other work highlights the crucial role of implicit processes, which may mediate to a large extent emotion regulation in day-to-day-life (Conner and Barrett, 2005; Greenwald and Banaji, 1995; Gyurak et al., 2011; Hetts et al., 1999; Mauss et al., 2007). Some have referred to implicit emotion regulation abilities as reflecting an "invisible shield", which can provide a buffer against the potential negative effects of emotions and facilitate improved mental health and emotional wellbeing (Bargh and Williams, 2006; DeWall et al., 2011; Gilbert et al., 1998; Koole et al., 2015; Mauss et al., 2007).

While a categorical "all or nothing" approach to distinguishing between implicit and explicit regulatory processes has a certain intuitive appeal, recent theoretical work suggests a more nuanced conceptualisation. Such work asserts that adaptive emotion regulation involves the dynamic interplay between implicit and explicit regulatory processes (Koole et al., 2015). As an example of the "porous" boundaries between implicit and explicit regulatory processes, the extent to which initially demanding regulation strategies are reliant upon effortful control can diminish over time and habitual use (Drabant et al., 2009; Gyurak et al., 2011; Yuan et al., 2015). In addition to the automatic implementation of regulatory strategies, implicit emotion regulation also encompasses other processes that may occur at the earliest stages of response to an emotional stimulus. For example, the capacity to maintain goal-directed behaviours and inhibit the distraction that irrelevant emotional stimuli/experiences can entail

(Tottenham et al., 2011), and the ability to implicitly monitor one's emotional experience and adopt appropriate goals that motivate regulatory intervention (Koole et al., 2015).

1.3.3. Distinction between emotion generation and emotion regulation

While research on emotion regulation has seen a dramatic increase over the past few decades, an ongoing debate persists regarding the extent to which emotion regulation can be meaningfully distinguished from emotion generation (Gross and Feldman-Barrett, 2011). A simple distinction between these constructs asserts that emotion generation comprises the processes through which an emotion is elicited, and emotion regulation refers to the processes that serve to modify these emotion-generative processes (Gross et al., 2011). However, this distinction may not be so clear-cut as evidence suggests overlap in the processes and neural substrates of emotion generation and regulation (Ochsner et al., 2009), leading some to assert that a clear distinction between these constructs is not possible (Kappas, 2011).

In the context of this thesis, I argue that distinguishing emotion regulation from emotion generation at a conceptual level serves a useful function so long as certain caveats are taken into account. A primary concern associated with distinguishing these sets of processes relates to the temporal sequence that such a distinction can imply (Gross et al., 2011). Given the aforementioned definition of emotion generation and regulation, it may be intuitive to infer that emotion generation processes unfold prior to the regulatory processes that can act upon them. While this may indeed be the case in many situations, there may also be instances in which regulatory processes occur alongside, or even precede, emotion generative processes (see reviews by Gross and Feldman-Barret, 2011; Gross et al., 2011).

In sum, this thesis adopts a definition of emotion regulation similar to that asserted by Gross and colleagues (e.g. Gross, 2015; Gross et al., 2011), referring to processes that can act upon and alter the processes that constitute emotion generation. Critically, I assert that regulatory processes need not necessarily occur after emotion generation, and that the two sets of processes can at times occur in parallel. While I do refer to emotion regulation as a distinct construct, I acknowledge the close relationship between these processes and those associated with emotion generation and recognise that it can often be difficult to disambiguate the unique influence that each may have on the trajectory of one's emotional response in a given situation. Given that regulatory processes may exert an influence at the earliest stages, and often without awareness or intent (Gyurak et al., 2011; Mauss et al., 2007), it is likely that an individual's emotional reactivity (i.e. the intensity with which they are prone to experience emotions) can be a reflection of both emotion generative and regulatory processes.

1.4. Relationship between empathy and emotion regulation

In this section I discuss relevant literature regarding the relationship between empathy and emotion regulation and highlight current gaps in our knowledge that this thesis seeks to address. A close relationship between empathy and emotion regulation has been proposed by previous theoretical accounts (e.g. Decety, 2010; Zaki, 2014), and there is strong overlap in the neural implementation and component processes associated with these constructs. For instance, the processes and neural substrates of reappraisal show significant overlap with those involved in the cognitive component of empathy (Kalisch, 2009; Mcrae et al., 2010; Ozonoff and McEvoy, 1994; Ozonoff et al., 1991; Sabbagh et al., 2006; Urry et al., 2009). Such work is suggestive of a relationship between empathy and emotion regulation.

In their discussion of the association between empathy and emotion regulation, Schipper and Petermann (2013) suggest that the relationship between these two abilities is bi-directional. They posit that not only can regulatory processes influence one's capacity to understand and share others' emotions, but that empathic processes can influence one's capacity for adaptive emotion regulation. Consistent with such theoretical work, this thesis asserts that the processes that underlie empathy and emotion regulation are closely related and seeks to test empirically the association between the various component processes that these complex multidimensional constructs comprise.

Of the handful of previous studies that have explored the relationship between empathy and emotion regulation, most have focused upon the moderating effect of emotion regulation on the association between affective empathy and different empathic outcomes (e.g. sympathy and personal distress; Okun et al., 2000), and prosocial behaviours (Lockwood et al., 2014). The key assertion of such work is that an optimal level of emotion regulation enables the observer to resonate with the negative emotions of others while maintaining arousal at a level where the observer does not become overly distressed by the other's state. The focus of this thesis is not upon how emotion regulation relates to different outcomes of empathy per se, but rather how the different cognitive and affective component processes associated with empathy are related to different emotion regulation abilities.

While not their primary focus, the aforementioned research examining the impact of emotion regulation on different empathic outcomes provides some evidence suggestive of a direct relationship between empathy and emotion regulation. For example, self-report measures of one's capacity to understand others' emotional states are positively related to the habitual use of reappraisal (Lockwood et al., 2014; Powell, 2018; Tully et al., 2016). Similarly, the self-reported capacity to take the perspective of others is negatively related to dispositional measures of emotion dysregulation (Contardi et al., 2016; Eisenberg and Okun, 1996; Okun et al., 2000). While relatively little work has directly examined the relationship between cognitive/affective empathy and emotion regulation, some clues as to the nature of their potential relationship can be found through examination of prior work that has studied these two constructs in isolation.

1.4.1. Evidence from atypical populations

Findings from studies of atypical populations provide evidence of shared deficits in emotion regulation and empathy in certain psychopathologies. Relative to typical controls, individuals with autism spectrum conditions (ASC) exhibit poor performance on measures of ToM/cognitive empathy, and also report higher levels of emotion dysregulation (Konstantareas and Stewart, 2006). ASC individuals also report greater use of maladaptive regulation strategies, such as suppression, and less frequent use of adaptive strategies, such as reappraisal (Samson et al., 2012). Borderline personality disorder (BPD) is a condition characterised by difficulties regulating emotions and is often associated with atypically high levels of affective empathy (Fertuck et al., 2006; Lang et al., 2012). Such findings suggest that the cognitive and affective dimensions of empathy may share different relationships with emotion regulation.

1.4.2. Social appraisals and emotion generation/regulation

Our emotions are often influenced by those around us; regulating the emotional state elicited by another's actions can at times necessitate being able to take their perspective in order to understand the motivations and intentions underlying their behaviours. Think for instance of an occasion in which someone's behaviour has angered you. Component processes related to cognitive empathy may facilitate being able to put yourself in their perspective and infer that their behaviour was justified and that the negative response they evoked in you was not the other's intention. As this example highlights, empathic processes could facilitate emotion regulation in situations where one's emotional response was triggered by another individual. Empathic processes might also influence emotion generative and regulatory processes in instances where another individual was not the trigger for one's emotion.

Building upon prior work on appraisal theory, Manstead and Fischer (2001) proposed that in a given situation the object of one's appraisals are not simply the "event" itself, but that the behaviours and emotional responses of other individuals present in that situation may also be appraised, and thus, influence the individual's emotional response. To illustrate this point, consider an example of a nervous flyer who becomes anxious during a bout of turbulence. While their appraisal of the event itself may induce strong anxiety and fear, this experience may be attenuated by evidence that other passengers and the flight crew are clearly not concerned by the situation. The authors refer to these appraisals of others' emotional responses to an event as social appraisals (Manstead and Fischer, 2001).

Social appraisals are likely dependent upon one's ability to attend and accurately interpret relevant cues pertaining to others' emotions, which are mediated by various empathic processes. Thus, it stands to reason that an individual's propensity and ability to engage empathic processes may play an important role in determining their emotional responses. Critically, given the close relationship between appraisal and reappraisal processes (which are typically differentiated only by the point in time at which they occur; Uusberg et al., 2019), the work discussed above suggests that one's ability to understand others' emotional experiences may influence their own regulatory, as well as emotion generative processes.

1.4.3. Overlap in cognitive control processes and neural substrates

Further evidence of a close association between empathy and emotion regulation comes from research that has highlighted partial overlap in the neural networks and cognitive control processes that underlie key component processes associated with these constructs. The term cognitive control (often executive function) refers to a range of processes that govern high-level control of action and facilitate abilities such as planning and attentional flexibility. While the different sub-components of cognitive control have been defined in various ways, key processes commonly referred to are: working memory, inhibition, and set-shifting (Miyake et al., 2000).

There is evidence to suggest that similar cognitive control processes play a critical role in both empathy and emotion regulation. Firstly, cognitive empathic abilities and emotion/self-regulation show similar developmental trajectories and are related to the development of general cognitive control functions (Carlson et al., 2004; Joseph and Tager-Flusberg, 2004; McRae et al., 2012; Wade et al., 2018). Further, there is evidence that different processes related to cognitive empathy and emotion regulation rely to varying degrees upon set-shifting, working memory, and inhibitory control (Austin et al., 2014; Gokcen et al., 2016; Hendricks and Buchanan, 2016; Mcrae et al., 2013), and are associated with overlapping activation in regions of the prefrontal cortex (PFC) (Happé et al., 1996; Kalisch, 2009; Leopold et al., 2012; Mcrae et al., 2010; Ochsner and Gross, 2005; Ozonoff et al., 1991; Ozonoff and McEvoy, 1994; Sabbagh et al., 2006).

The ability to attribute an emotional/mental state to another individual requires various cognitive control processes, which facilitate the necessary coordination of self and other representations (Carlson et al., 2004; Carlson and Moses, 2001; Decety and Sommerville, 2003; Flynn, 2007; Hansen, 2011; Hughes and Ensor, 2007; Perner and Lang, 1999). Prior work provides evidence suggestive of a close relationship between cognitive control abilities and cognitive empathy/ToM (Austin et al., 2014; Gokcen et al., 2016; Hughes and Ensor, 2007; Marcovitch et al., 2015; Mutter et al., 2006). Further support for the role of cognitive control processes in understanding others' emotional/mental states comes from studies demonstrating that increased cognitive load can result in decreased performance on ToM/cognitive empathy tasks (Bull et al., 2008; McKinnon and Moscovitch, 2007).

Similar cognitive control processes to those associated with the cognitive component of empathy have also been implicated in emotion regulation, where they underlie the ability to regulate affect and exert control over one's behaviours (Rothbart and Rueda, 2005). While there are conflicting findings regarding the precise sub-components of cognitive control with which they are related, there is evidence to suggest that emotion regulation processes are dependent upon various cognitive control abilities (Hendricks and Buchanan, 2016; Salas et al., 2014; Schmeichel and Demaree, 2010; Schmeichel et al., 2008).

Neuroimaging studies broadly suggest that emotion regulation is associated with a dynamic interaction between cognitive control regions of the PFC/parietal cortex and subcortical regions associated with emotion generation. Specifically, it has been demonstrated that activity in these control regions of the PFC inhibits activations in emotion generation regions, such as the amygdala and insula (Banks et al., 2007; Drabant et al., 2009; Goldin et al., 2008; Ochsner et al., 2012; Urry et al., 2009; Wager et al., 2008).

In addition to being associated with the recruitment of similar domain-general cognitive control processes, there is considerable overlap in the way in which certain empathic and regulatory processes are conceptualised. For example, reappraisal via perspective-taking or cognitive-distancing (henceforth, distancing) (Messina et al., 2015; Webb et al., 2012a) involves taking a detached perspective from one's immediate egocentric experience (Cocking and Renninger, 1993; Ochsner, et al. 2004; Trope and Liberman, 2010). Distancing is conceptually similar to perspective-taking in that both involve a shift in perspective.

Consequently, one could argue that a greater ability to switch between self and other perspectives (a component process of cognitive empathy) might support the ability to regulate one's emotions using cognitive-distancing strategies. The capacity to adopt a more distanced perspective may also enable greater self-reflection, thereby facilitating other regulatory processes, such as the selection of appropriate strategies and the ability to generate alternative appraisals of a situation that might serve to modify one's emotional experience (Davis et al., 2011; Gruber et al., 2009; Katzir and Eyal, 2013; Kross and Ayduk, 2011; Ochsner and Gross, 2008; Wallace-Hadrill and Kamboj, 2016; Wisco and Nolen-Hoeksema, 2011).

In light of the findings discussed above, it is reasonable to infer that higher levels of cognitive empathy would be associated with improved emotion regulation abilities; this may be particularly true for more cognitively demanding regulatory processes. While cognitive empathic abilities may support emotion regulation, as I now discuss, the opposite could be true of affective empathy.

Individuals with greater affective empathy exhibit increased facial mimicry responses to others' emotions (Sonnby-Borgstrom, 2002), which in turn have been shown to relate to increased self-reported resonance with the mimicked emotion (Hatfield et al., 1993; Laird et al. 1994; Wild et al., 2001). Furthermore, there is some evidence to suggest that greater affective empathy may be associated with increased emotional reactivity in a more general sense (Rueckert et al., 2011). Given that emotional stimuli/experiences can have a deleterious effect on the efficiency of cognitive control processes (Tottenham et al., 2011), the increased emotional reactivity associated with higher levels of affective empathy could interfere with one's ability to engage the often demanding processes necessary for emotion regulation. Therefore, in contrast to cognitive empathy, it is possible that greater affective empathy would be associated with a diminished ability to utilise more cognitively demanding regulatory strategies.

1.4.4. Emotional awareness and understanding

In addition to the overlap in the processes and neural substrates by which they are mediated, there is reason to infer that empathy and emotion regulation may be related in other ways. For instance, empathy not only enables one to understand the emotional states of others but may also support the capacity to be aware of and understand one's own emotional experiences. Many authors posit that self-understanding is a critical component of socio-cognitive abilities such as cognitive empathy/ToM

(Hobson, 2010; Frith and Frith, 2003). Indeed, a recent study found evidence to suggest that individuals who are better at differentiating their own negative emotional states, were also more accurate in recognising the emotional expressions of others (Israelashvili et al., 2019).

An awareness and understanding of one's own emotions is a fundamental prerequisite for adaptive emotion regulation: In order to effectively influence our emotional experiences, we must first of all recognise what we are feeling and why (van Rijn et al., 2011; Subic-Wrana et al., 2014). Indeed, it has been shown that greater clarity with regards to one's own emotions is associated with the use of more adaptive emotion regulation strategies (Gohm and Clore, 2002) and a greater ability to implement reappraisal (Fustos et al., 2013). Furthermore, the capacity to detect and understand the somatic experiences associated with emotion (i.e. interoceptive awareness) may support regulatory processes in various ways. For example, improved interoceptive awareness can enable the detection of emotional responses at an early stage, which may support the generation of appropriate regulatory goals and facilitate the selection and implementation of regulatory processes prior to the emergence of a full blown emotional response (Craig, 2008; Fustos et al., 2013; Gross, 2015).

In sum, it is possible that the improved awareness and understanding of one's own emotions, associated with higher levels of empathy, could facilitate the ability to regulate one's emotions effectively. By the same logic, low levels of empathy could entail difficulties with emotional awareness/clarity, which might serve as a trigger for maladaptive emotion regulation (Schipper and Petermann, 2013).

1.5. Summary, aims, and hypotheses

In this chapter, I have discussed background literature relevant to the studies reported in this thesis. In the first section, I described the different component processes of empathy, with a focus upon the distinction between the cognitive and affective components that support the capacity to understand and/or resonate with another individual's emotions. I then provided a broad overview of emotion regulation, focusing upon models that distinguish between different regulatory processes based upon 1) the point within the emotion generation process at which they intervene, and 2) the extent to which they are reliant upon conscious, effortful implementation and monitoring. In the final section, I discussed extant theoretical and empirical work that provides some insight into the potential nature of the relationship between these constructs.

In sum, there is evidence suggestive of a close bidirectional relationship between empathy and emotion regulation; however, to date there has been little systematic study of how the distinct cognitive and affective components of empathy relate to different emotion regulation processes. Additionally, of the handful of studies that have explored this relationship, most have relied solely upon self-report measures of both constructs.

While self-report questionnaires represent a useful source of information, empathy and emotion regulation are complex multidimensional constructs and a sole focus upon respondents' self-perceptions of these abilities may be insufficient to fully capture their true complexity.

Various studies provide evidence of divergence between trait and task measures of empathy (e.g. Devlin et al., 2014; Melchers et al., 2015; Michalska et al., 2013), which suggests that these different approaches may not assess the same underlying constructs. A fundamental distinction between trait and task measures is their focus upon respondents' self-perceived abilities (trait) versus their actual abilities (task), which may not necessarily show strong convergence. While task measures can provide a more objective index of one's ability, trait measures may be more susceptible to response biases, such as overestimation of one's abilities and/or socially desirable responding (Gerdes et al., 2010; Moskowitz, 1986; Paulhus, 1991). Furthermore, trait measures reflect respondents' dispositional behaviours and experiences, which are likely to be relatively stable over time. In contrast, task measures typically assess more short-term "state-level" responses, which may be more susceptible to contextual variability (Gross and John, 2003; Nezlek et al., 2007).

A further important distinction between trait and task measures of empathy and emotion regulation is the extent to which they index one's ability or propensity to engage these processes. Empathizing with another's emotion can come with certain emotional and cognitive costs, and one may often be motivated to avoid engaging empathic processes (Cameron et al., 2019; see Cameron et al., 2018 and Zaki, 2014 for reviews). Thus, it is not only one's ability to attend to another's emotion cues, mimic/resonate with their experience, and/or place oneself in their perspective that is important, but also one's motivation to engage these processes (Gehlbach, 2004; Keysers and Gazzola 2014).

In light of the above considerations, this thesis utilised a combination of trait and task measures of empathy and emotion regulation. This approach enables a more holistic examination of the relationship between empathy and emotion regulation, capturing aspects related to participants' self-perceived and actual ability to implement these processes, as well as their dispositional propensity to do so (Kagan, 2007; Russell-Smith et al., 2013; Moskowitz, 1986).

This thesis addresses current gaps in the literature by testing the hypothesis that individual differences in empathy are associated with variability in emotion regulation abilities. Across five empirical chapters, the relationship between empathy and emotion regulation is examined using a range of questionnaires and tasks, incorporating self-report, behavioural, eye-tracking, and psychophysiology measures. Based on the evidence discussed in this chapter, it was predicted that different component processes associated with empathy would be differentially related to different components of emotion regulation. Broadly speaking, I predicted that emotion regulation abilities would be positively related to cognitive empathy but negatively related to affective empathy.

Each chapter begins with a brief review of the relevant literature, on which the specific hypotheses for the reported studies were based. I begin by exploring the relationship between empathy and emotion regulation using self-report (trait) measures of both constructs (chapter 2). I then build upon these findings by testing these same relationships using more objective task measures of component processes of cognitive and affective empathy (chapter 3). In subsequent chapters, I test the relationship between trait empathy and task measures of different emotion regulation abilities (chapters 4, 5, 6). An overview of the key focus of each empirical chapter is provided in table 1.1.

Table 1.1. Summary overview of empirical chapters in this thesis

	Empathy Measure	ER Measure	Aims
Ch2	Trait (QCAE)	Trait (ERQ; habitual strategy use) Trait (DERS; difficulties with emotion regulation)	Examine the relationship between cognitive/affective empathy and self-reported emotion dysregulation and the habitual use of reappraisal and suppression
Ch3	Task (SFM; affective empathy) Task (DT; cognitive empathy) Task (RMET; cognitive empathy)	Trait (ERQ; habitual strategy use) Trait (DERS; difficulties with emotion regulation)	Examine the relationship between task measures of cognitive/affective empathy and self-reported emotion dysregulation and the habitual use of reappraisal and suppression
Ch4	Trait (QCAE)	Task (Emo-Go/NoGo) Task (Emo-Stroop)	Examine the relationship between trait empathy and task measures of implicit emotion regulation
Ch5	Trait (QCAE)	Task (Implicit reappraisal) Task (Explicit reappraisal)	Examine the relationship between trait empathy and task measures of reappraisal
Ch6	Trait (QCAE) Task (SFM; affective empathy) Task (DT; cognitive empathy)	Task (Spontaneous recovery) Task (Instructed regulation)	Examine the relationship between trait and task measures of cognitive/affective empathy and task measures of spontaneous emotional recovery and instructed emotion regulation

QCAE: *questionnaire of cognitive and affective empathy*
ERQ: *emotion regulation questionnaire*
DERS: *difficulties in emotion regulation scale*
SFM: *spontaneous facial mimicry (associated with affective empathy)*
DT: *director task (associated with cognitive empathy)*
RMET: *reading the mind in the eyes test (associated with cognitive empathy)*

Chapter 2

Trait measures of empathy and emotion regulation

2.1. Introduction

It is thought that the individual in possession of the traits under investigation should be best placed to provide the most accurate information regarding their own thoughts, experiences, and behaviours (Kagan, 2007; McCrae and Costa, 1999; Paulhus and Vazire, 2007). Accordingly, self-report questionnaires are one of the predominant methods used to assess variability in personality constructs such as empathy (Robins et al., 2007). While performance-based tasks can provide more objective measures, the link between a given trait and a specific behaviour may not always be direct and some aspects of a construct may be most amenable to measurement via self-report (Furr and Funder, 2007).

This chapter reports two studies that tested the relationship between empathy and emotion regulation using trait measures of both constructs. Study (1), examines how trait cognitive and affective empathy are associated with the habitual use of an adaptive and maladaptive regulation strategy; study (2) examines the relationship between trait empathy and difficulties with various aspects of emotion regulation.

2.1.1. Trait measures of empathy

With reference to the conceptualisation of empathy discussed in the introductory chapter, trait empathy can be viewed as reflecting an individual's perceived *ability* and *motivation* to engage different empathic processes (Gehlbach, 2004; Keysers and Gazzola, 2014). Various questionnaire measures have been developed to assess different components of empathy; as their development was often based upon slightly different conceptualisations of empathy there is some variability in the precise facets they assess (Reniers et al., 2011). Some trait measures, such as the Hogan Empathy Scales (HES; Hogan, 1969) and Empathy Quotient (EQ; Baron-Cohen and Wheelwright, 2004) give greater prominence to the cognitive dimension of empathy, whereas others, such as the Questionnaire Measure of Emotional Empathy (QMEE; Mehrabian and Epstein, 1972), focus upon the affective dimension. Given the multidimensional nature of empathy, trait measures that enable the assessment of the affective and cognitive dimensions as related but dissociable constructs may provide the most useful insight into how different components of empathy relate to emotion regulation.

The Questionnaire of Cognitive and Affective Empathy (QCAE; Reniers et al., 2011) is a more recent multidimensional trait measure of empathy. The QCAE measures the cognitive and affective dimensions of empathy with improved precision over previous multidimensional measures (e.g. the Interpersonal Reactivity Index, Davis, 1983), which often conflated these facets of empathy with more general abilities and/or constructs that should be considered distinct from empathy, such as sympathy and personal distress (Baron-Cohen and Wheelwright, 2004; Jolliffe and Farrington, 2006; Lawrence et al., 2004; Reniers et al., 2011).

2.1.2. Trait measures of emotion regulation

While task-based measures of emotion regulation are useful for understanding the short-term effects of different regulatory strategies, their focus upon the relatively immediate consequences make them less helpful for understanding how individuals regulate their emotions in daily life (Gross and John, 2003). Task measures of emotion regulation are discussed further in later chapters (chapters 4, 5, and 6); the focus of this chapter is upon self-report measures that assess respondents' dispositional regulatory behaviours and experiences.

The Emotion Regulation Questionnaire (ERQ; Gross and John, 2003) measures the extent to which respondents habitually use reappraisal and suppression strategies day-to-day. A key benefit of the ERQ is that it captures the use of both an adaptive antecedent-focused strategy and a maladaptive response-focused regulation strategy (reappraisal and suppression, respectively). Prior work has demonstrated significant individual differences in the propensity to use these two strategies, which are associated with dramatically different consequences in terms of both their short-term efficacy and relationship with social functioning and emotional wellbeing (Cutuli, 2014; Gross and John, 2003; John and Gross, 2004).

Useful insight can be obtained through understanding the strategies individuals typically use to regulate their emotions; however, a sole focus upon habitual strategy use may overlook other abilities crucial for effective emotion regulation (Greenberg et al., 2017; Gross, 2015; Kaufman et al., 2016). The Difficulties in Emotion Regulation Scale (DERS; Gratz and Roemer, 2004) adopts a broader perspective, measuring respondents' experiences of difficulties with various aspects of emotion regulation. While initially developed to examine emotion dysregulation in clinical populations, the DERS has proven effective for use in typical adult populations (Kaufman et al., 2016).

2.1.3. The current studies

This chapter examines how trait cognitive and affective empathy are related to the self-reported use of reappraisal and suppression (study 1), and self-reported experiences of emotion dysregulation (study 2). Prior to presenting the hypotheses of these studies, I provide a brief discussion of evidence regarding the potential relationships that trait cognitive and affective empathy may share with these measures of emotion regulation.

The tendency to automatically mimic the emotional facial expressions of those around us reflects a fundamental mechanism through which resonance with others' emotions is elicited (Chartrand and Dalton, 2008; de Waal and Preston, 2017; Hatfield et al., 1993; Preston and de Waal 2002). Given that suppression involves attempts to manage one's emotions by inhibiting their expression (Gross, 2015), a tendency to use this strategy could interfere with mimicry/embodiment processes, thereby diminishing the extent to which the individual resonates with others' emotional experiences. Mimicry/embodiment of another's emotions can also support the capacity to understand their emotional experiences as the somatic state they evoke may provide useful information that one can draw upon in order to make inferences about what the other is feeling (Chartrand and Bargh, 1999; Hatfield et al., 1993; Preston and de Waal, 2002). Additionally, given evidence to suggest that suppression may diminish the availability of cognitive resources (Wang et al., 2014) it is possible that individuals who regularly use this strategy will be less able to engage the cognitive control processes necessary for representing and understanding others' emotions. In light of the above evidence, it was predicted that both dimensions of empathy would show a negative relationship with the habitual use of suppression.

Reappraisal reflects an effortful regulatory strategy, reliant upon various facets of cognitive control mediated by the PFC (Buhle et al., 2014; Messina et al., 2015; Webb et al., 2012a). Similar brain regions and cognitive control processes are associated with the cognitive component of empathy, where they mediate the ability to coordinate the coactive self and other representations in service of perspective taking and mental state attribution (Carlson et al., 2004; Dennis et al., 2009; Goel et al., 1995; Gokcen et al., 2017; Hansen, 2011; Saxe et al., 2004). Given this overlap, it is possible that higher cognitive empathy is associated with greater efficiency of the processes that support reappraisal.

Moreover, our emotions are often influenced by those around us; regulating how we feel in response to another's actions can at times necessitate being able to take their perspective in order to understand the motivations and intentions that underlie their behaviours. Given that reappraisal may often directly rely upon cognitive empathic processes it is possible that those with higher trait cognitive empathy will show an increased ability, and thus, propensity to use reappraisal in day-to-day life. Indeed, one prior study has reported a positive relationship between trait cognitive empathy and reappraisal use (Lockwood et al., 2014).

Given the potentially deleterious effect of emotional arousal on the cognitive control processes (Hare et al., 2005, 2008; Tottenham et al., 2011), the increased emotional reactivity associated with higher levels of affective empathy (Rueckert et al., 2011; Sato et al., 2013) could impede one's ability to utilise more cognitively demanding strategies such as reappraisal. Consequently, it was predicted that higher trait affective empathy would be associated with a reduced propensity to use reappraisal. While Lockwood et al. (2014) found no evidence of a relationship between affective empathy and reappraisal, the sample size in this study may have lacked the power to detect effects of a smaller magnitude.

A divergence between the cognitive and affective dimensions of empathy might also be expected for other components of emotion regulation, particularly those that are reliant upon cognitive control processes, such as the ability to control emotional impulses and maintain a focus upon goal-oriented behaviours in emotional situations. Based on the evidence previously discussed, it was predicted that trait emotion dysregulation would show a negative relationship with cognitive empathy but would be positively related to affective empathy. A summary of the hypotheses for the two studies reported in this chapter is presented below.

1) *Higher cognitive empathy will be associated with greater use of reappraisal, lower use of suppression, and lower levels of emotion dysregulation.*

2) *Higher affective empathy will be associated with lower use of reappraisal and suppression, and higher levels of emotion dysregulation.*

2.2. Trait empathy and the use of reappraisal and suppression

2.2.1. Methods

2.2.1.1. Participants

An a priori sample size estimation was conducted using G*Power 3.1. (Faul et al., 2007). Based on a small to moderate correlation between reappraisal use and trait cognitive empathy reported by Lockwood et al. (2014), a minimum sample size of 67 was required to obtain power of .80 at an alpha level of p = .05. For reasons of convenience, data were collected from both the UK and Denmark, with the goal of collecting two subsamples of approximately 100 participants. While no specific differences across these two subsamples were predicted, the data from each sample was analysed to examine the consistency of the observed results.

In total, 220 participants (161 female) were recruited from in and around the campuses of the University of Reading, UK (N = 94) and Aarhus University, Denmark (N = 126), using the online research panel and campus-based advertisements. All questionnaires were completed online in English and participants were reimbursed in the form of course credits or enrolment in a lottery to win free cinema tickets. The mean age of the overall sample was 21.96 (*SD* = 5.67). Ethical approval was obtained from the research ethics committees of the Universities of Reading and Aarhus, and informed consent was provided by all participants.

2.2.1.2. *Materials*

Empathy. Trait empathy was measured using the Questionnaire of Cognitive and Affective Empathy (QCAE; Reniers et al., 2011). The QCAE is a 31-item self-report questionnaire assessing respondents' capacity to understand and resonate with the emotions of others. It comprises five subscales which track onto the two core dimensions of empathy (cognitive and affective). The cognitive empathy dimension assesses one's propensity to take another's perspective and accurately infer their state (e.g. "When I am upset at someone, I usually try to 'put myself in his shoes' for a while", "I can sense if I am intruding, even if the other person does not tell me"). The affective empathy dimension comprises items assessing respondents' tendency to resonate with others' emotions (e.g. "I am happy when I am with a cheerful group and sad when the others are glum", "It affects me very much when one of my friends seems upset").

Participants rated their response to each item using a 4-point scale, ranging from "strongly disagree" to "strongly agree"; higher values reflect greater levels of trait empathy. Cronbach's alpha within the total (N = 220) sample was high for both QCAE dimensions ($\alpha_{\text{Cognitive empathy}}$ = .90; $\alpha_{\text{Affective empathy}}$ = .84). Cronbach's alpha was consistently high within the UK (N = 94, $\alpha_{\text{Cognitive empathy}}$ = .90; $\alpha_{\text{Affective empathy}}$ = .84) and Denmark (N = 126, $\alpha_{\text{Cognitive empathy}}$ = .90; $\alpha_{\text{Affective empathy}}$ = .84) subsamples. Details of each QCAE item and scale coding are provided in appendix A.

Reappraisal & suppression use. Reappraisal and suppression use were measured using the Emotion Regulation Questionnaire (ERQ; Gross and John, 2003). The ERQ is a 10-item questionnaire measuring respondents' habitual propensity to use reappraisal and suppression. Each item is rated using a 7-point scale, ranging from "strongly disagree" to "strongly agree"; higher values reflect greater habitual use of each strategy. Cronbach's alpha for the reappraisal and suppression subscales were acceptable within the total (N = 220) sample, $\alpha_{\text{Reappraisal}}$ = .85; $\alpha_{\text{Suppression}}$ = .77); similar alpha levels were observed within each sub sample: UK (N = 94, $\alpha_{\text{Reappraisal}}$ = .80;

$\alpha_{Suppression}$ = .76), Denmark (N = 126, $\alpha_{Reappraisal}$ = .86; $\alpha_{Suppression}$ = .78). Details of each ERQ item and scale coding are provided in appendix B.

2.2.1.3. *Data Reduction & Analyses*

The relationship between trait empathy and regulation strategy use was examined using bivariate correlations. Normality of each variable was assessed using Kolmogorov Smirnov tests. Accordingly, Spearman's rho is reported for correlations where any variable distribution showed significant deviation from normality. All correlations are reported as two-tailed, with a significance threshold of $p < .05$. To ensure that the observed results were not unduly influenced by a small number of outlier cases, the same analyses reported in this results section were also conducted following the removal of univariate and bivariate outlier cases (see appendix D).

2.2.2. Results

Trait empathy and reappraisal use

Cognitive empathy was significantly positively correlated with the use of reappraisal, *rho*(218) = .25, $p < .001$. There was no relationship between affective empathy and reappraisal use, *rho*(218) = .05, $p = .42$. These two correlations were significantly different, Steiger's Z = 2.42, $p = .02$ (see fig. 2.1). A consistent pattern of results was observed within both subsamples: UK (CE-reappraisal, *rho*(92) = .29, $p = .004$, AE-reappraisal, *rho*(92) = .02, $p = .88$); Denmark (CE-reappraisal, *rho*(124) = .21, $p = .02$; AE-reappraisal, *rho*(124) = .09, $p = .34$).

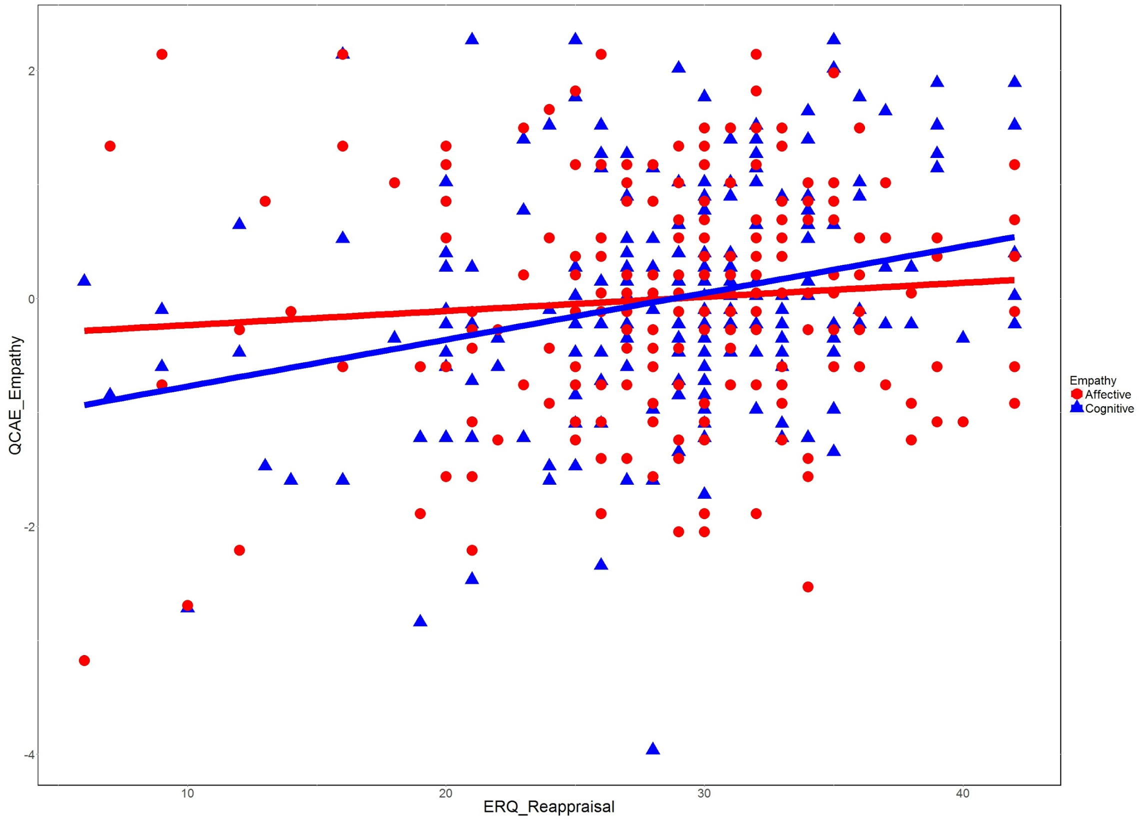

Fig. 2.1. Scatterplot showing the relationship between reappraisal use (ERQ) and Z-transformed cognitive/affective empathy (QCAE). Cognitive empathy (blue) showed a positive correlation with reappraisal use; affective empathy (red) showed no relationship with reappraisal use.

Trait empathy and suppression use

Trait cognitive and affective empathy both showed significant negative correlations with the habitual use of suppression (*rho*(218) = -.16, p = .02; *rho*(218) = -.26, $p < .001$, respectively). These correlations were not significantly different, Steiger's Z = 1.27, p = .20 (fig. 2.2). While the correlation between cognitive empathy and suppression did not reach significance in the UK sample, the pattern of results across both subsamples were broadly consistent: UK (CE-suppression, *rho*(92) = -.11, p = .30; AE-suppression *rho*(92) = -.29, p = .005); Denmark (CE-suppression *rho*(124) = -.21, p = .02, AE-suppression *rho*(124) = -.23, p = .008).

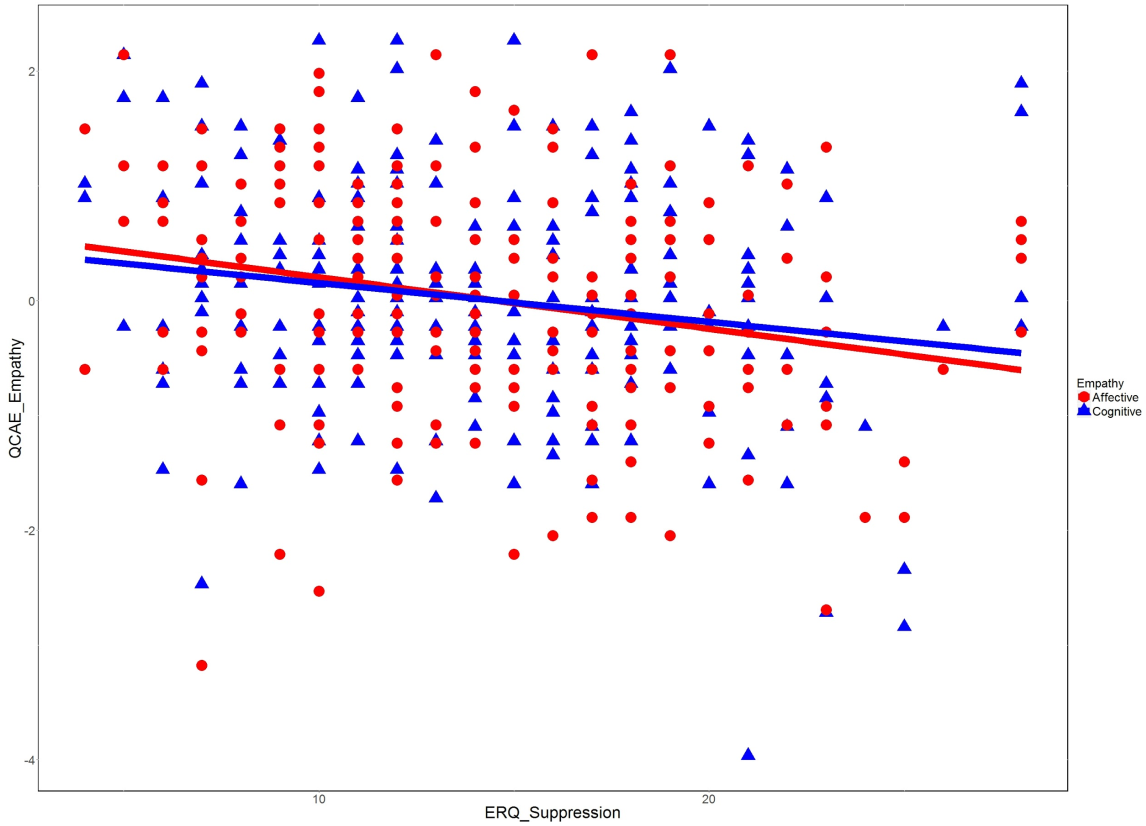

Fig. 2.2. Scatterplot showing the relationship between suppression use (ERQ) and Z-transformed trait cognitive/affective empathy (QCAE). Cognitive empathy (blue) and affective empathy (red) were both negatively correlated with suppression use.

2.3. Trait empathy and emotion dysregulation

2.3.1. Methods

2.3.1.1. Participants

A sample of 137 participants (101 female) was recruited from the University of Reading campus. The mean age of the sample was 20.26 years (*SD* = 3.01). Recruitment was via the university online research panel and all participants were awarded course credit for participation. Questionnaires were completed online. Ethical approval was obtained from the University of Reading research ethics committee.

2.3.1.2. *Materials*

Empathy. Trait empathy was measured using the QCAE (Reniers et al., 2011) (see section 2.1.3. for details). Cronbach's alpha was high for both empathy dimensions ($\alpha_{\text{Cognitive Empathy}}$ = .88; $\alpha_{\text{Affective Empathy}}$ = .82).

Emotion dysregulation. Trait emotion dysregulation was measured using the Difficulties in Emotion Regulation-short form (DERS-SF; Kaufman et al., 2016). The DERS-SF (henceforth, DERS) is an 18-item questionnaire assessing difficulties in six aspects of emotion regulation: 1) awareness of emotions (awareness), 2) clarity/understanding of emotions (clarity), 3) acceptance of emotions (non-acceptance), 4) capacity to maintain goal-directed behaviours in emotional situations (goals), 5) control over emotional impulses (impulse), and 6) ability to effectively manage one's emotional responses (strategies). Participants reported the extent to which they experience difficulties in these aspects of emotion regulation using a 5-point Likert scale, where 1 = almost never (0-10% of the time) and 5 = almost always (91-100% of the time); higher ratings reflect increased emotion dysregulation. The ratings of the six subscales are summed to provide a total score reflecting overall levels of emotion dysregulation (DERS-Total). Within this sample, the DERS-Total score, and each subscale demonstrated acceptable to high Cronbach's alpha: $\alpha_{\text{DERS-Total}}$ = .91; $\alpha_{\text{Awareness}}$ = .79; α_{Clarity} = .86; $\alpha_{\text{Acceptance}}$ = .82; α_{Goals} = .89; α_{Impulse} = .89; $\alpha_{\text{Strategies}}$ = .83. Details of each DERS item and scale coding are provided in appendix C.

2.3.1.3. *Data Reduction & Analyses*

The relationship between empathy and emotion dysregulation was examined using bivariate correlations. Normality of each variable was assessed using Kolmogorov-Smirnov tests. Accordingly, Spearman's rho is reported for correlations where any variable distribution showed significant deviation from normality. All correlations are reported as two-tailed, with a significance threshold of $p < .05$. For reference, the results following the removal of univariate and bivariate outliers are reported in appendix D.

2.3.2. Results

Cognitive empathy showed a significant negative correlation with DERS-Total scores, *rho*(135) = -.18, $p = .04$. Affective empathy was not significantly correlated with DERS-Total, *rho*(135) = .13 , $p = .14$. These two correlations were significantly different, Steiger's Z = -3.3, $p = .001$ (fig. 2.3).

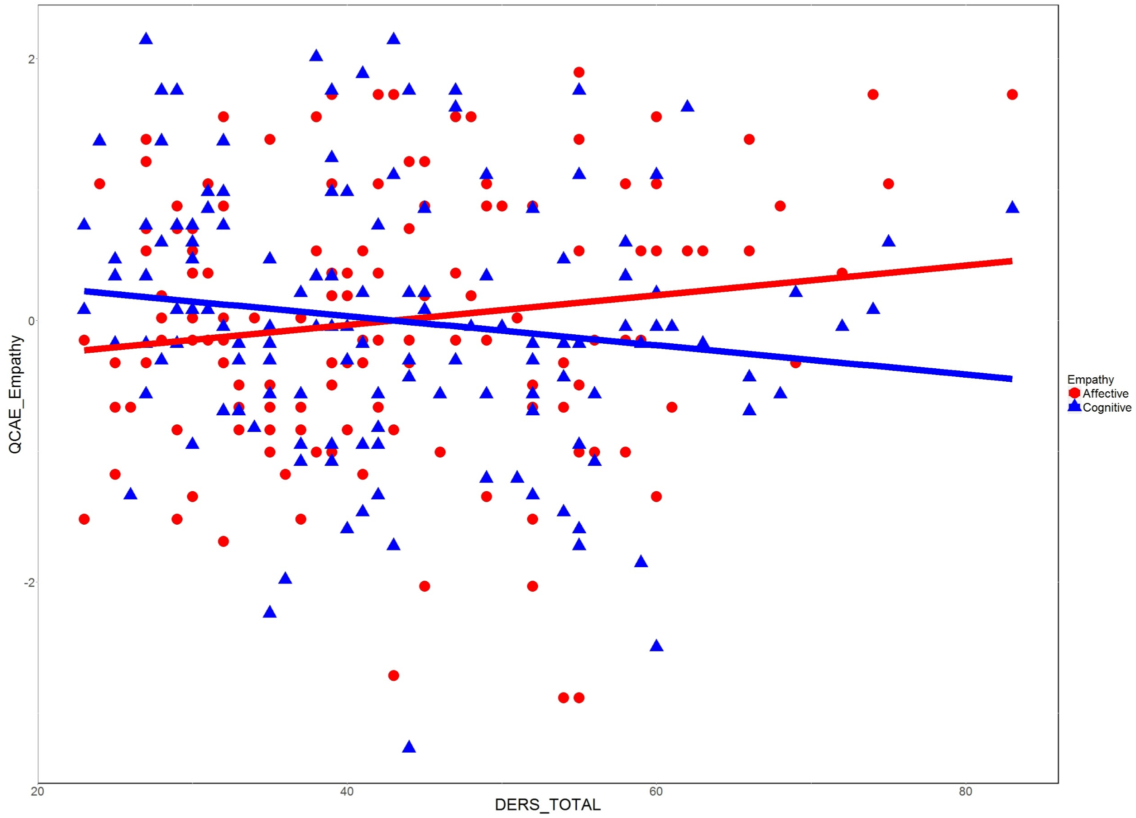

Fig. 2.3. Scatterplot showing the relationship between Z-transformed trait cognitive/affective empathy (QCAE) and overall levels of emotion dysregulation (DERS-Total). Cognitive empathy (blue) was negatively correlated with DERS-Total; affective empathy (red) was not significantly correlated with DERS-Total.

To better understand the relationship between cognitive/affective empathy and trait emotion dysregulation, exploratory analyses were conducted to examine the relationship between these two dimensions of empathy and each subscale of the DERS. Cognitive empathy was significantly negatively related to the awareness and impulse subscales and showed a trend-level negative relationship with clarity, non-acceptance, and strategies. There was no relationship between cognitive empathy and the goals subscale of the DERS.

Affective empathy was significantly positively related to the DERS goals and strategies subscales and showed a trend-level positive relationship with non-acceptance. Affective empathy was negatively related to awareness but showed no relationship with clarity or impulse control. Steiger's tests demonstrated that with the exception of the clarity subscale, the cognitive and affective dimensions of empathy showed different relationships with each subscale of the DERS (all correlation coefficients and associated Steiger's test Z statistics are reported in table 2.1).

Table 2.1.
Correlation coefficients for cognitive/affective empathy and DERS

Variable	Awareness	Clarity	Non-Acceptance	Goals	Impulse	Strategies
Cog Empathy	-.40***	-.16	-.15	.11	-.17*	-.10
Aff Empathy	-.22**	-.01	.16	.29**	.04	.23**
Steiger's (CE-AE)	-2.38**	-1.58	-3.42***	-4.36***	-2.31*	-3.6***

*< .05, ** < .01, *** < .001

2.4. Discussion

2.4.1. Summary of findings

Across two studies the relationship between trait measures of empathy and emotion regulation was examined. It was predicted that the two dimensions of empathy would both be negatively related to the use of suppression but share different relationships with the habitual use of reappraisal (ERQ; Gross and John, 2033) and self-reported emotion dysregulation (DERS; Kaufman et al., 2016). The observed results broadly support these hypotheses and highlight significant patterns of divergence in the relationships that trait cognitive and affective empathy share with habitual regulation strategy use and emotion dysregulation. The results suggest that while higher cognitive empathy is broadly associated with more adaptive emotion regulation, higher affective empathy is associated with increased difficulties with certain aspects of emotion regulation.

Trait cognitive and affective empathy were both negatively related to the habitual use of suppression. While higher cognitive empathy was associated with more frequent use of reappraisal, affective empathy showed no relationship with reappraisal use. The two dimensions of empathy also showed divergent patterns in their relationships with trait emotion dysregulation. Cognitive empathy was negatively related to overall levels of emotion dysregulation, suggesting that those with greater cognitive empathy experience fewer difficulties with emotion regulation. In contrast, affective empathy did not show a significant relationship with overall levels of emotion dysregulation. Significant divergence between cognitive and affective empathy were also observed for various subscales of the DERS.

During the writeup of these studies a paper was published that reported the same relationships between reappraisal use and trait cognitive and affective empathy in a large UK sample (Powell, 2018). Additionally, a study by Contardi et al. (2016) was published after the present studies were conducted, and reported similar relationships between trait empathy and emotion dysregulation in a sample of Italian students. The findings of the current studies provide further support for this recent work by replicating the findings in a large sample from two countries.

Aside from the negative relationship between cognitive empathy and suppression, which was not found in the Lockwood et al. (2014) study, the current results show a consistent pattern with prior work (Contardi et al., 2016; Powell, 2018; Tully et al., 2016). Furthermore, by examining how trait empathy is associated with the different subscales of the DERS, the current study provides greater specificity regarding the relationship that cognitive and affective empathy share with different aspects of emotion dysregulation. While the correlational design of these studies precludes the ability to make direct attributions of cause and effect, some potential interpretations of these results are now discussed in relation to extant theoretical and empirical work.

2.4.2. Cognitive empathy & emotion regulation

Trait cognitive empathy was broadly associated with more adaptive emotion regulation in both studies, demonstrated by more frequent use of adaptive reappraisal strategies, less frequent use of maladaptive suppression strategies, and lower trait emotion dysregulation. The negative relationship between cognitive empathy and emotion dysregulation was driven primarily by relationships with DERS subscales assessing difficulties with emotional awareness and impulse control. The cognitive component of empathy is reliant upon various cognitive control processes, which support the ability to take another's perspective and make accurate inferences about their mental/emotional state (Carlson et al., 2004; Dennis et al., 2009; Goel et al., 1995; Gokcen et al., 2017; Hansen, 2011; Saxe et al., 2004). Given that many forms of adaptive emotion regulation are reliant upon similar processes (Buhle et al., 2014; Goldin et al., 2008; Hendricks and Buchanan, 2016; Kalisch, 2009; McRae et al., 2012), it could be that higher cognitive empathy is associated with improved efficiency of the cognitive control processes that also underlie the ability to regulate one's emotions effectively. Conversely, lower levels of cognitive empathy may impede the ability to implement adaptive but cognitively demanding regulation strategies such as reappraisal.

Cognitive empathy was negatively associated with difficulties with emotional awareness, suggesting that individuals with greater cognitive empathy show a heightened awareness of their own emotional experiences. This finding is consistent with prior work, which asserts that cognitive empathic abilities may support the capacity to reflect upon and understand one's own emotions (Frith and Frith, 2003; Happé et al., 1996; Hobson, 2010). Given that the capacity to be aware of and understand one's own emotions may facilitate the ability to select and implement a regulation strategy suitable to a given context (Fustos et al., 2013; Gross, 2015), this heightened emotional awareness could in part explain why cognitive empathy was associated with more adaptive patterns of strategy use.

The negative correlation between trait cognitive empathy and suppression use suggests that individuals with higher cognitive empathy are less likely to use this strategy in their daily lives. As individuals with cognitive empathy experience fewer difficulties with emotion regulation and show a heightened propensity to use reappraisal, they may simply be less reliant upon maladaptive strategies such as suppression. This result could also be interpreted by considering the inverse relationship between these two constructs. Given that suppression can have a negative impact upon cognitive control processes (Wang et al., 2014), the frequent use of this strategy could interfere with the processes that mediate the ability to take another's perspective and make inferences about their state. Furthermore, the frequent use of suppression could inhibit mimicry/embodiment mechanisms (Chartrand and Bargh, 1999; Hatfield et al., 1993; Preston and de Waal, 2002), which might impede one's ability to understand others' emotions through embodied simulation.

2.4.3. Affective empathy & emotion regulation

Affective empathy was not significantly associated with overall trait emotion dysregulation but was significantly positively correlated with subscales assessing difficulties with managing one's emotions and maintaining goal-focused behaviours in emotional situations. In contrast, affective empathy was negatively related to difficulties with emotional awareness, suggesting that similar to cognitive empathy, greater affective empathy may facilitate the capacity to be aware of one's own emotions. The divergent relationships that affective empathy shared with these sub-scales of the DERS could explain why it did not show a significant positive relationship with the overall emotion dysregulation (i.e. DERS-Total) metric.

Higher levels of affective empathy are associated with increased arousal in response to others' emotions (Sonnby-Borgstrom, 2002), and may relate to heightened emotional reactivity in a more general sense (Rueckert et al., 2011). Given that emotions can interfere with the cognitive control processes upon which many aspects of adaptive emotion regulation are reliant (Hare et al., 2005; Tottenham et al., 2011), the increased emotional reactivity associated with higher affective empathy may diminish the capacity to regulate one's emotions effectively. While the heightened emotional awareness that greater affective empathy entails could facilitate certain aspects of emotion regulation, such as the selection of adaptive regulation strategies, the concurrent difficulties in maintaining goal-focused behaviours may negatively impact the implementation of more demanding regulatory strategies. This could explain why affective empathy showed no relationship with reappraisal use, despite being associated with improved emotional awareness, which ought to facilitate the selection of adaptive strategies such as reappraisal (Gross, 2015).

The negative relationship between affective empathy and the habitual use of suppression suggests that more frequent use of this strategy is associated with a reduced capacity to share others' emotions. The emotional resonance by which affective empathy is defined is largely driven by spontaneous mimicry mechanisms, which can automatically elicit in the observer an emotional state isomorphic to that of the perceived other (Hatfield et al., 1993; Laird et al. 1994; Wild et al., 2001). Consequently, it is unsurprising that individuals who frequently attempt to suppress any outward indicators of their emotions (e.g. facial expressions) report a diminished capacity/propensity to resonate with the emotions of others.

2.4.4. Summary, conclusions, and limitations

The findings of these studies support the hypothesis that empathy and emotion regulation are related. Critically, they suggest that the cognitive and affective dimensions of empathy share different relationships with the habitual use of reappraisal and various aspects of emotion dysregulation. While these findings represent an important first step in further elucidating the relationship between different components of empathy and emotion regulation, it is important to highlight certain limitations of these studies.

These studies utilised only self-report measures of empathy and emotion regulation, which, while helpful in understanding respondents' self-perceptions of their empathic and emotion regulation abilities (Dziobek et al., 2008) are not without their inherent limitations. Firstly, given that many of the processes associated with both empathy and emotion regulation can occur on an implicit level (Decety and Jackson, 2004; Gyurak et al., 2011;

Mauss et al., 2007; Pfeifer et al., 2008; Singer and Lamm, 2009), one could argue that certain features of these constructs may be difficult to assess accurately via introspection (Kagan, 1988). However, I would assert that while respondents may be unable to directly reflect upon the underlying processes associated with these constructs, the subsequent consequences of their empathic/regulatory abilities are likely available to perception.

A further limitation of trait measures is their reliance on retrospective self-reporting, which may leave them susceptible to inaccuracies and response biases (Moskowitz, 1986) such as socially desirable responding (Gerdes et al., 2010; Paulhus, 1991). In the present studies, all questionnaires were completed online and participants were explicitly informed that their responses would remain entirely confidential. This anonymity should have helped reduce the potential that any socially desirable responding was present in the data, and there is no reason to infer that participants would have been motivated toward impression management to any extent that might have impacted the results in a demonstrable way.

Finally, a fundamental limitation of using only trait measures is that they are unable to accurately capture more ability-based components of empathy, which may be more amenable to measurement using performance-based task approaches. Indeed, prior work highlights a lack of convergence between trait and task measures of empathy (e.g. Melchers et al., 2015), which could suggest that these approaches are assessing slightly different latent constructs. One key distinction between trait and task measures is the extent to which they capture one's propensity or ability to engage empathic processes or use different regulatory strategies. More specifically, trait measures reflect a combination of respondents' self-perceived abilities and motivation to engage different empathic and regulatory processes, which may not necessarily be directly related to one's objective ability to implement these processes effectively.

Subsequent chapters of this thesis seek to build upon the findings of these studies in various ways. To address the limitations of using only trait measures of empathy, the next chapter examines the same relationships tested here using more objective task-based measures of different component processes of empathy. Later chapters utilise a range of tasks that directly assess some of the key aspects of emotion regulation found to be related to empathy in the present studies. For example, in chapter 4, the relationship between cognitive/affective empathy and performance-based measures of the ability to inhibit impulsive responses and maintain goal-focused behaviours in the presence of salient emotional distractors is examined. Finally, to build upon the findings suggestive of divergent relationships between cognitive/affective empathy and reappraisal, chapter 5 reports two studies that examined how these components of empathy are associated with task metrics assessing the ability to downregulate negative emotions using reappraisal.

Chapter 3

Trait emotion regulation and task measures of cognitive and affective empathy

3.1. Introduction

The results of the trait analysis reported in the previous chapter suggest that the cognitive and affective dimensions of empathy share different relationships with emotion regulation. While trait measures provide an indication of respondents' self-perceived levels of cognitive/affective empathy (Dziobek et al., 2008), they are less effective in capturing key ability-based components of these constructs (Russell-Smith et al., 2013). More objective indicators of these abilities can be obtained using task-based approaches. This chapter builds upon the findings of chapter 2 by examining the relationship between empathy and trait emotion regulation using established task paradigms that assess abilities related to distinct component processes of empathy.

Cognitive empathy was measured using two tasks that assess participants': (1) ability to take another individual's perspective, and (2) ability to accurately infer complex emotional/mental states based on subtle facial cues. A fundamental process associated with affective empathy was assessed using electromyographic (EMG) measures of spontaneous facial mimicry (SFM), which provide a proxy index of participants' propensity to resonate with others' emotions. I begin with a brief overview of these task measures of empathy before moving on to discuss evidence regarding their potential relationship with trait emotion regulation.

3.1.1. Task measures of cognitive empathy

The cognitive component of empathy comprises various abilities that enable the observer to take the perspective of another individual and make inferences about their emotional/mental state (Blair, 2005; Davis, 1983; Shamay-Tsoory, 2011). Broadly speaking, this cognitive component encompasses two partially dissociable categories of processes: (1) self-other control processes, which enable the observer to suppress their own egocentric perspective in order to take the perspective of another; (2) inferential processes, which facilitate the recognition and interpretation of various cues from which another's mental/emotional state can be understood (Bird and Viding, 2014; Decety, 2010).

The capacity to inhibit one's default egocentric perspective in order to take the perspective of another individual is a critical component process supporting the ability to understand others' emotions (Decety and Chaminade, 2003; Frith and Frith, 2003; Shanton and Goldman, 2010). Humans typically interpret incoming information based on their own perspective (Coburn et al., 2015; Wimmer and Perner, 1983), and in order to accurately represent another individual's experience, which may be different from one's own, this egocentric bias must be inhibited.

Failure to adequately inhibit one's default self-perspective can result in egocentric interference, whereby one's own knowledge, beliefs, and visual perspective can impact the accuracy with which one is able to infer another's experience (Camerer et al., 1989; Derbyshire et al., 2013; Epley et al., 2004; O'Connell et al., 2015; Schmid and Schmid-Mast, 2010; Silani et al., 2013; Todd et al., 2015). Suppressing one's egocentric bias is cognitively demanding and has been shown to be associated with cognitive control processes mediated in part by the PFC (Bailey and Henry, 2008; Healey and Grossman, 2018; Lamm et al., 2011; Saxe et al., 2004).

The director task (henceforth DT) is a visual perspective-taking paradigm commonly used to examine perspective-taking abilities in typical adult populations (Keysar et al., 2003). Participants are required to move objects positioned on a shelving unit in response to instructions delivered by a "director" who is facing them from the opposite side of the shelves. A subset of the objects visible to the participant are occluded from the director's view, meaning that on critical trials there is a conflict between the perspective of the participant and the director. For example, an instruction to move "the big cup", referring to the largest cup visible to both director and participant, might lead the participant to initially consider as a target the largest cup visible to them, which cannot be seen by the director (foil object). To respond correctly, participants must inhibit their prepotent egocentric perspective in order to correctly interpret the director's instruction and select the mutually visible cup to which they were actually referring (target object).

Behavioural measures, such as response time (RT) difference between conflict (experimental) and no-conflict (control) trials are sometimes used to assess DT performance. However, more recent studies utilise eye-tracking metrics as more objective and informative indicators of perspective-taking ability (e.g. Rubio-Fernández, 2017). Gaze fixations are widely accepted as reflecting one's focus of attention and information processing (Altmann and Kamide, 1999; Just and Carpenter, 1980; Tanenhaus et al., 1995). Tracking an individual's eye gaze patterns during the DT enables the direct measurement of the extent to which they exhibit an egocentric bias (by considering the foil object as a possible target) and how efficiently they were able to suppress this initial bias (Rubio-Fernández, 2017; Symeonidou et al., 2016).

While perspective-taking processes play an important role in the cognitive component of empathy, the capacity to understand others' emotional experiences is also mediated by other abilities, such as those that enable the observer to make accurate inferences about what another individual may be thinking/feeling (Adolphs, 2009; Gallese et al., 2004; Vellante et al., 2013). These inferential processes are reliant upon the observer's ability to interpret the often subtle cues that may indicate another's emotion, such as facial expressions, body language, and prosody (Baron-Cohen, 1995; Frith and Frith, 2006). A task commonly used to measure this ability is the Reading the Mind in the Eyes Test (henceforth RMET; Baron-Cohen et al., 1997, 2001).

The RMET assesses participants' ability to correctly identify complex mental/emotional states based solely upon images of the eye region and is typically considered a measure of advanced theory of mind (ToM), a construct synonymous with cognitive empathy. Performance on the RMET is thought to rely upon the relatively automatic process of matching the perceived expressions to relevant expression archetypes and terminology stored in memory (Baron-Cohen et al., 2001; Vellante et al., 2013). In contrast to the original version (Baron-Cohen et al., 1997), the revised RMET includes only complex emotional/mental states (e.g. embarrassed, jealous), which necessitates the process of attributing a belief to the target and is less prone to ceiling effects in typical adult populations (Baron-Cohen et al., 2001; Vellante et al., 2013). While contrasting findings have been reported (e.g. Olderbak et al., 2015; Pinkham et al., 2018), studies have demonstrated that the RMET has sufficient sensitivity to assess variability in cognitive empathy/ToM in typical (Ahmed and Miller, 2011; Peterson and Miller, 2012) and atypical populations (e.g. ASC; Baron-Cohen et al., 1997; Baron-Cohen et al., 2001).

3.1.2. Task measures of affective empathy

The human predisposition to spontaneously mimic the emotional facial expressions of others can induce in the mimicker a state isomorphic to the perceived emotion and reflects a fundamental component process associated with affective empathy (de Waal and Preston, 2017; Hatfield et al., 1993; Preston and de Waal 2002). Spontaneous facial mimicry (SFM) has been studied empirically using facial electromyography (fEMG), which provides a sensitive measure of rapid and automatic emotional responses that may be difficult to detect using other methods (Tassinary and Cacioppo, 1992).

There is considerable evidence that the perception of emotional facial expressions evokes activity in congruent muscle groups (e.g. the Zygomaticus major in response to happy faces, and Corrugator supercilii in response to angry faces) (Cacioppo et al., 1986; Dimberg and Petterson, 2000; Hess et al., 1998; Rymarczyk et al., 2018; Sims et al., 2012). SFM can occur rapidly and automatically (Dimberg, 1990; Dimberg and Thunberg, 1998), even when the individual is not aware of the presence of a face (Bornemann et al., 2012; Dimberg et al., 2000).

Facial muscle activity is believed to have a direct influence upon one's affective state (Ekman et al., 1983; Hennenlotter et al. 2009; Levenson et al., 1990), which suggests that mimicking another's emotional displays could trigger a corresponding state in the observer. Indeed, prior work has demonstrated that SFM magnitude is positively correlated with self-report indices of congruent emotional experiences (Gump and Kulik, 1997; Sato et al., 2013; Wild et al., 2001). Furthermore, blocking facial mimicry can attenuate activations in subcortical regions associated with emotional (Hennenlotter et al. 2009) and reward-related processing (Hsu et al., 2018).

Critically, the magnitude of SFM is positively related to trait measures of affective empathy (Dimberg et al., 2011; Sonnby-Borgstrom, 2002), suggesting that it can provide a reliable proxy measure of one's propensity to resonate with others' emotions.

3.1.3. The current study

This study examined the relationship between empathy and trait measures of emotion dysregulation (DERS; Kaufman et al., 2016) and the habitual use of reappraisal/suppression (ERQ; Gross and John, 2003) using objective task measures of different component processes associated with cognitive and affective empathy. An eye-tracking version of the DT was used to assess perspective-taking ability, with the relative gaze time on target versus foil objects indexing participants' efficiency in suppressing their egocentric bias. An additional component of cognitive empathy was measured using the RMET, which provides an index of participants' ability to infer complex mental/emotional states based on images of the eye region. Finally, affective empathy was assessed using an emotional face perception task, wherein the fEMG-measured magnitude of Zygomaticus major (ZM) and Corrugator supercilii (CS) activation in response to happy and angry faces was used to index participants' propensity to resonate with others' emotions. Broadly speaking, it was predicted that the cognitive and affective components of empathy would show different relationships with trait emotion dysregulation, and the habitual use of different regulation strategies.

Given its reliance upon cognitive control processes also necessary for adaptive emotion regulation (Buhle et al., 2014; Carlson et al., 2004; Dennis et al., 2009; Goldin et al., 2008; Hendricks and Buchanan, 2016; Saxe et al., 2004), it was predicted that greater perspective-taking ability would be associated with lower levels of emotion dysregulation and more adaptive strategy selection (i.e. greater use of reappraisal and lower use of suppression). The specificity of this relationship was tested by examining the relationship between trait emotion regulation and an additional ability relevant to the cognitive component of empathy, as assessed by the RMET. Successful performance on the RMET is thought to rely upon more automatic processing of emotional information (Baron-Cohen et al., 2001; Vellante et al., 2013), and is therefore likely to be less reliant than the DT upon cognitive control processes associated with emotion regulation. Consequently, it was predicted that RMET performance would show no relationship with trait measures of emotion regulation.

Given the potentially deleterious effect that emotional arousal can have on the cognitive control processes necessary for effective emotion regulation (e.g. Tottenham et al., 2011), it was predicted that a heightened propensity to resonate with others' emotions, as indexed by greater SFM, would be associated with increased trait emotion dysregulation and a reduced propensity to use reappraisal. While the studies reported in chapter 2 found no evidence of a relationship between trait affective empathy and reappraisal use, and a positive relationship with only certain aspects of emotion dysregulation, this could be due to issues with trait measures conflating different components of empathy. For example, in order to report the extent to which one tends to resonate with others' emotions, one must first of all have the capacity to recognise these states in others (an ability associated with the cognitive component of empathy). As SFM reflects a more objective and "pure" measure of one's propensity to resonate with others' emotions (i.e. affective empathy), I expected it to show a different relationship with trait emotion regulation than the trait empathy measures used in chapter 2.

Finally, the negative relationship between suppression use and trait affective empathy reported in chapter 2, suggests that the habitual use of this strategy might interfere with the mimicry/embodiment processes that mediate the capacity to resonate with others' emotions. Thus, it was predicted that SFM magnitude would be negatively related to the use of suppression. A summary of the study hypotheses is highlighted below.

1) *Perspective-taking ability* (DT) *will be associated with lower levels of emotion dysregulation and suppression use. Perspective-taking ability will be positively associated with reappraisal use.*

2) *Mental state attribution accuracy* (RMET) *will show no relationship with trait emotion dysregulation or reappraisal/suppression use.*

3) *SFM magnitude will be positively related to emotion dysregulation and show a negative relationship with suppression and reappraisal use.*

3.2. Methods

3.2.1. Participants

An a priori sample size estimation was conducted using G*Power 3.1. (Faul et al., 2007). Based on the expectation that these task measures of empathy would show stronger relationships with trait emotion regulation than the trait empathy measures used in chapter 2, the sample size estimation suggested that a sample of 44 would be required to detect correlations of a moderate to large effect size at an alpha level of p = .05, with power of .80. Forty-eight right-handed participants (31 females) were recruited from the UOR campus via the online research panel and poster advertisements.

All participants completed the DT and SFM tasks; a subsample of N = 40 participants also completed the RMET. The mean age of the sample was 21.29 yrs (SD = 4.03). One participant, for whom the necessary questionnaire data was incomplete, was removed prior to analysis. Following data quality checks, five participants were removed from the SFM task and eight participants were removed from the DT (see *Facial EMG recording and processing*, and *Eye-tracking recording and processing* sections for details). Reimbursement was in the form of either course credit or cash payment of £7 per hour. Questionnaires were completed online and the tasks as part of a lab session, which also included the emotion regulation task reported in chapter 6. The order of task completion was counterbalanced across the sample. Ethical approval was obtained from the UOR research ethics committee.

3.2.2. Materials & Procedure

Emotion dysregulation. Trait emotion dysregulation was measured using the DERS-SF (Kaufman et al., 2016). The DERS-Total score demonstrated high internal consistency within this sample, $\alpha_{\text{DERS-Total}}$ = .89.

Reappraisal and suppression use. The habitual use of reappraisal and suppression was measured using the ERQ (Gross and John, 2003). Cronbach's alpha was acceptable for both subscales of the ERQ: $\alpha_{\text{Reappraisal}}$ = .79, $\alpha_{\text{Suppression}}$ = .77.

Director task. Stimuli consisted of computerised images of a 4x4 shelving unit containing various objects. There were six object sets, each comprising six different objects. Each object set was used on four control trials and four experimental trials, with a different instruction for each trial. While all objects were visible to the participant, two objects were always located on shelves where the backs were covered, meaning they were not visible to the director. The director was physically present in the room and sat opposite participants facing a monitor positioned back to back with the monitor on which participants completed the task. This approach was used in order to increase the ecological validity over previous versions of the DT in which a "virtual" director is used. A photograph of the director facing the participant through the shelves was visible on the monitor.

Participants were informed that the director would verbally instruct them to move a particular object to a particular location, and that they should take into account which objects are visible to the director (see appendix E for full instructions). The target object referred to in the director's instruction was always one of three similar objects. For instance, where the instruction referred to a cup, a small, medium, and large cup were all present. Instructions on experimental trials referred to a target object that was visible only to the participant. For example, the instruction to move the "big cup" could induce participants to consider the foil object (i.e. the largest cup visible to them) as the target. However, the correct target would be the largest cup visible to both the participant and director. To respond correctly participants must inhibit their egocentric perspective in order to select the object that matches the instruction from the director's perspective. There were two types of conflict on experimental trials: spatial (e.g. "move the top/bottom cup") and size (e.g. "move the big/small cup"). There was no conflict on control trials as the director's instruction referred to a mutually visible object (e.g. the instruction to "move the small cup" referred to the smallest cup, which was visible to both director and participant) (fig. 3.1).

Each trial started with a central fixation cross which remained on screen as the scripted instruction was delivered verbally by the director. Immediately following the instruction, the director pressed the spacebar and the stimuli were presented on the monitor after a 400 ms delay. The cursor was not visible until the participant clicked the mouse button. Once the cursor appeared, participants then clicked on the target object then on the new location, at which point the display was updated to show the selected object in the new location. Participants were instructed that they should administer their first mouse click only once they have decided upon the target object and the new location. Response time (RT) was calculated as the interval between stimulus onset and the first mouse click. The task comprised 48 trials in total (24 experimental, 24 control) and lasted approximately 15 minutes. Trial order was pseudorandom, with no more than 3 trials of either condition in succession. Trial order was reversed for half of the sample. This DT differed from previous versions in that there was no trial time limit and participants completed six practice trials, three of which involved seeing the shelves as the director would see them.

Fig. 3.1. Example of trial stimuli from the participant's perspective in the Director task. Instructions on experimental trials referred to an object occluded from the director's perspective, e.g. "the big cup". The comparable control trial instructions for the same stimuli referred to a mutually visible object, e.g. "the small cup".

Eye-tracking recording & processing

Gaze data were recorded using a Tobii X2-60 eye-tracker recording at 60Hz, positioned below the monitor on which the task was completed. Participants' eye-gaze patterns were tracked during the initial "decision period" from stimulus onset until the first mouse click, thereby providing an indication of the objects being considered as potential targets. The display was separated into 16 regions corresponding to each shelf area. Analyses focused upon the key regions of interest, which were the shelves on which the target and foil objects were located. Any gaze points within the corresponding shelf regions were classified as a gaze to the target/foil.

The key metric extracted from this task as a measure of perspective-taking ability was the duration of time spent looking at the target relative to the foil object on experimental trials. This metric was calculated by dividing target gaze time by foil gaze time, with larger values reflecting more efficient egocentric suppression (i.e. perspective-taking ability). In contrast to previous measures, such as the time it takes for the participant to look at the correct target object, this metric does not assume that the first look at the target object denotes the point at which egocentric bias has been successfully inhibited and can account for instances in which participants may look back and forth between the target and foil before making their decision. To isolate experimental trials that tapped into this ability there were two criteria for inclusion: (1) participants had to look at the foil object (to ensure egocentric bias was induced), and (2) a correct response had to follow (to ensure egocentric bias was successfully inhibited).

A technical fault led to gaze data from one participant not being recorded. To maintain data quality, any participant for whom more than ⅓ of overall gaze points were not detected were removed (7 participants). Of the remaining N = 39 sample, any trials where more than ⅓ of gaze points were not detected (56 trials), and/or in which RT deviated from the overall mean by more than 3*SD (67 trials) were removed. Given the aforementioned inclusion criteria, any trials in which the foil object was not looked at were not included in our metric of egocentric suppression (94 trials). Following these exclusions, all participants retained at least 10 experimental trials from which the perspective-taking ability metric was calculated ($M \pm SD$ = 19.1 ± 3.75).

Reading the mind in the eyes test. The RMET comprised 36 trials (preceded by one practice trial), in which participants were presented with a photograph depicting the eye region of different Caucasian actors (19 male, 17 female) portraying complex mental/emotional states (e.g. despondent, playful, nervous). Stimuli were presented centrally on the monitor, surrounded by four numbered mental state descriptors (e.g. 1. jealous, 2. panicked, 3. arrogant, 4. hateful) (fig. 3.2). One of the descriptors described the depicted mental/emotional state; the other three descriptors were incorrect foils. Participants were instructed to select the descriptor that best described what the target was thinking/feeling (see appendix E for full instructions).

There was no time limit on each trial and participants provided their response by pressing on the keyboard the number (1-4) corresponding to the relevant descriptor. A booklet containing definitions of each descriptor was provided to minimise the extent to which any variability in word comprehension might influence participants' accuracy on the task. Participants were encouraged to consult the definition booklet if they were unsure of the meaning of any descriptors. The key metric extracted from this task was participants' mean accuracy score.

Fig. 3.2. Example of trial stimuli from the RMET.

Spontaneous facial mimicry task. A component of affective empathy was assessed using a spontaneous facial mimicry (SFM) task, in which fEMG was used to measure CS and ZM activity during the passive viewing of emotional facial expressions. Facial stimuli were taken from the Mindreading™ set (Baron-Cohen et al., 2004), and comprised 4000 ms clips of four different targets (2 males, 2 females) displaying happy and angry facial expressions. Dynamic video stimuli were used as they provide greater ecological validity and have been shown to elicit greater SFM than static stimuli (Rymarczyk et al., 2011; Sato and Yoshikawa, 2006; Weyers et al., 2006). Stimuli were presented centrally on the monitor at a height of 16 cm, a width of 28 cm, and a frame rate of 30 fps. The task lasted approximately 5 minutes.

The task comprised 48 trials (24 happy, 24 angry), with each clip presented six times in a randomised order. Each trial consisted of the following sequence of events: (1) central fixation cross for 1000ms, (2) angry or happy facial expression clip for 4000 ms, (3) blank screen for 1000 ms (fig. 3.3). Participants were instructed simply to pay attention to the faces for the entirety of the task (see appendix E for full instructions). In accordance with prior SFM studies (e.g. Sims et al., 2012), in order to reduce the likelihood that participants were focusing on their facial muscles they were informed that the EMG sensors were measuring sweat gland activity.

Facial EMG recording and processing

EMG activity was measured using sensors positioned over the ZM and CS in accordance with the guidelines proposed by Fridlund and Cacioppo (1986). The skin was cleaned using 70% alcohol wipes, after which 4mm Ag/AgCl surface sensors (Discount Disposables, USA) filled with isotonic electrode gel (Mansfield R&D, UK) were attached bipolarly to the left side of the face using 5mm collars (Discount Disposables), at a distance of 10mm apart. A ground electrode was positioned over the left mastoid process.

The EMG signal was recorded using an ML-870 Power Lab, amplified 10,000 times by an ML-138 Octal Bioamp and recorded/processed using LabChart 8 (AD Instruments). The raw EMG signal was sampled at a rate of 1kHz, digitized with 16-bit precision. Digital 500 Hz low-pass and 50 Hz high-pass filters were applied to the signal offline. Data from three participants were removed due to technical issues resulting in poor quality recordings and/or lost event markers. Data were visually inspected and any trials with clear movement artefacts/noise or in which the mean CS or ZM activity deviated from the group mean by more than 3*SD were removed (92 trials). Following these removals, all participants had at least 12 trials per condition ($M \pm SD$ = 23.04 ± 2.38). The EMG data were rectified and logarithmically transformed to remove negative values and minimize the impact of any extreme values.

To test for the emergence of SFM, the magnitude of EMG activity during the presentation of the facial expression clips relative to a 1 second baseline during the fixation screen period, was examined (de Wied et al., 2009). The key metric extracted from this task as a measure of SFM was the mean baseline-corrected ZM activity for happy faces and CS activity for angry faces during the 2-4 second epoch following stimulus onset (fig. 3.3). This epoch was selected because the dynamic facial expressions reached maximal intensity at approximately the 2000 ms mark (Sims et al., 2012).

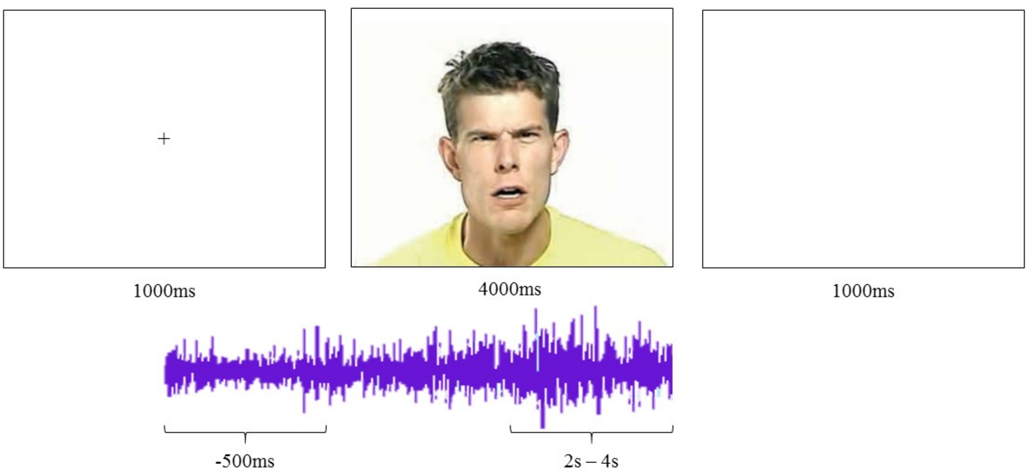

Fig. 3.3. Schematic of trial structure in the spontaneous facial mimicry task. The key metric of SFM extracted from this task was the mean baseline corrected CS (for angry faces) and ZM (for happy faces) activity within the 2-4 second epoch post stimulus onset.

3.2.3. *Data reduction and analyses*

To test for egocentric bias in the DT, paired samples t-tests were used to compare mean RT and the proportion of trials in which the foil object was looked at across the experimental and control conditions. To test for the emergence of SFM, separate repeated measures ANOVAs with emotion (happy/angry) and epoch (baseline/stimulus period) as within-subjects factors were conducted for the two dependent variables ZM and CS activity. Where the assumption of sphericity was not satisfied, Greenhouse Geisser corrected values are reported.

The key metrics extracted from each task for the correlation analysis were, (1) the relative proportion of gaze time on target versus foil objects on experimental trials in the DT, (2) mean accuracy on the RMET, and (3) mean baseline-corrected congruent muscle activity during the 2-4 second period in the SFM task. While not directly related to the study hypotheses, the relationship between these task measures of empathy and the QCAE were examined (see appendix E). Normality of each variable was assessed using Kolmogorov-Smirnov tests. Accordingly, Spearman's rho is reported for correlations where any of the variable distributions showed significant deviation from normality. All p-values are reported as 2-tailed, with a significance threshold of $p < .05$. To ensure that the observed results were not unduly influenced by a small number of outlier cases, the same analyses reported in the results section were conducted following the removal of univariate and bivariate outlier cases (see appendix E).

3.3. Results

3.3.1. Director task

Overall accuracy on the DT was high (M ± *SD* = 95.45% ± 4.01%). Mean RT was significantly longer on experimental (M ± *SD* = 3031.17 ms ± 748.13 ms) relative to control trials (M ± *SD* = 2948.63 ms ± 740.11 ms), $t(46) = 2.36$, $p = .02$ (fig 3.4). Analysis of the eye-gaze data showed that the foil object was looked at on a significantly greater proportion of experimental trials (mean ± *SD* = 87.61% ± 14.33%) relative to control trials (mean ± *SD* = 57.21% ± 16.35%), $t(38) = -14.05$, $p < .001$. Taken together, these results suggest that experimental trials successfully induced an egocentric bias, with participants' gaze patterns suggesting that they considered the foil object as a potential target.

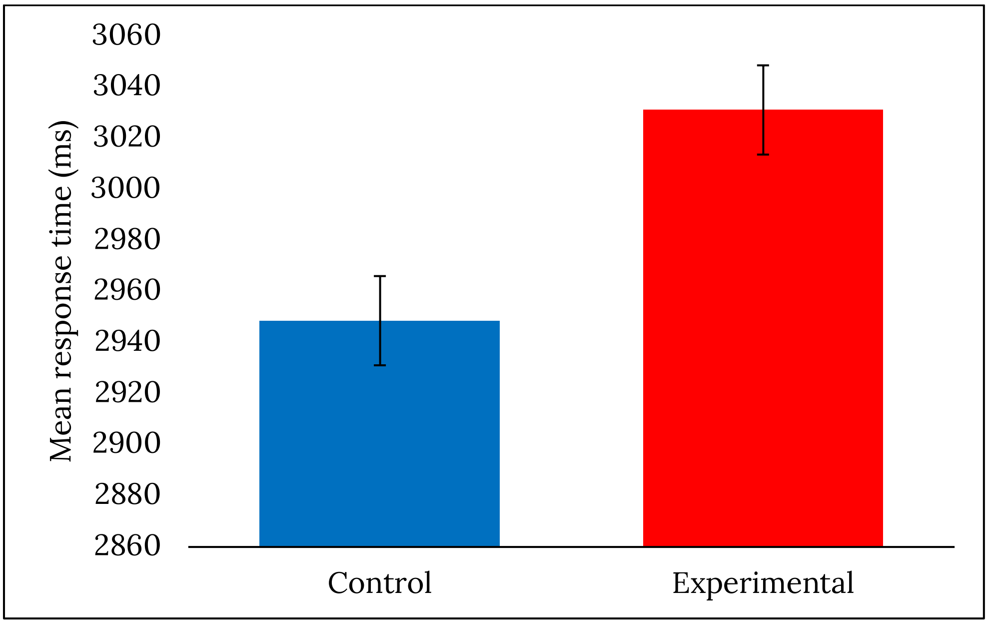

Fig. 3.4. Mean response time (ms) for experimental and control trials in the director task. Error bars depict ±1 within-subjects SEM.

DT correlations with trait emotion dysregulation

To examine the relationship between this task measure of perspective-taking ability and trait emotion dysregulation, I focused upon the experimental condition as these were the only trials in which participants were required to suppress their egocentric bias in order to correctly identify the target object referred to by the director. A large negative correlation between the DT perspective-taking metric and DERS-Total was observed, $r(37) = -.49$, $p = .002$ (fig. 3.5).

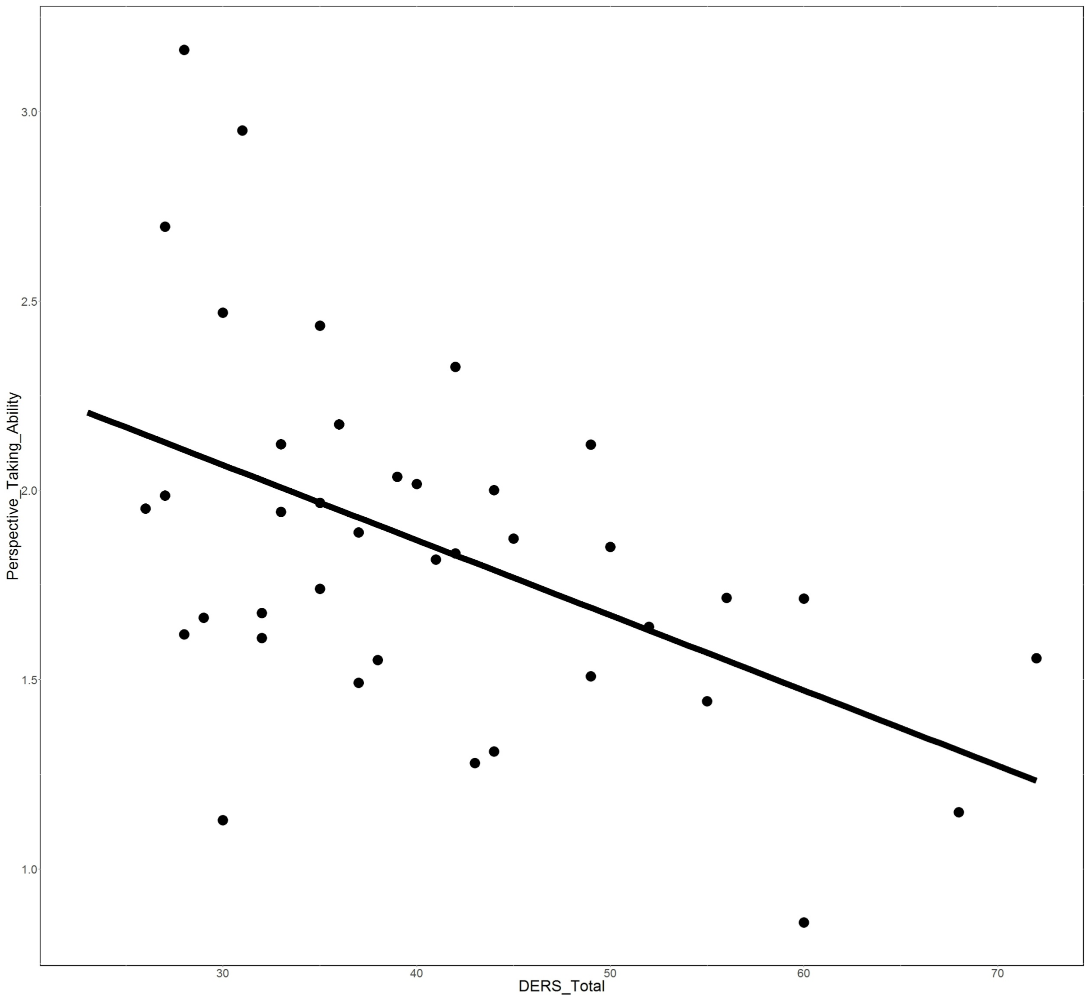

Fig. 3.5. Scatterplot showing the relationship between the director task perspective-taking metric (gaze time target/gaze time foil) and DERS-Total.

DT perspective-taking ability correlations with regulation strategy use

The DT perspective-taking metric was not significantly related to reappraisal use, *rho*(37) = .21, *p* = .21, but showed a trend-level negative relationship with suppression use, *r*(37) = -.31, *p* = .06 (fig. 3.6).

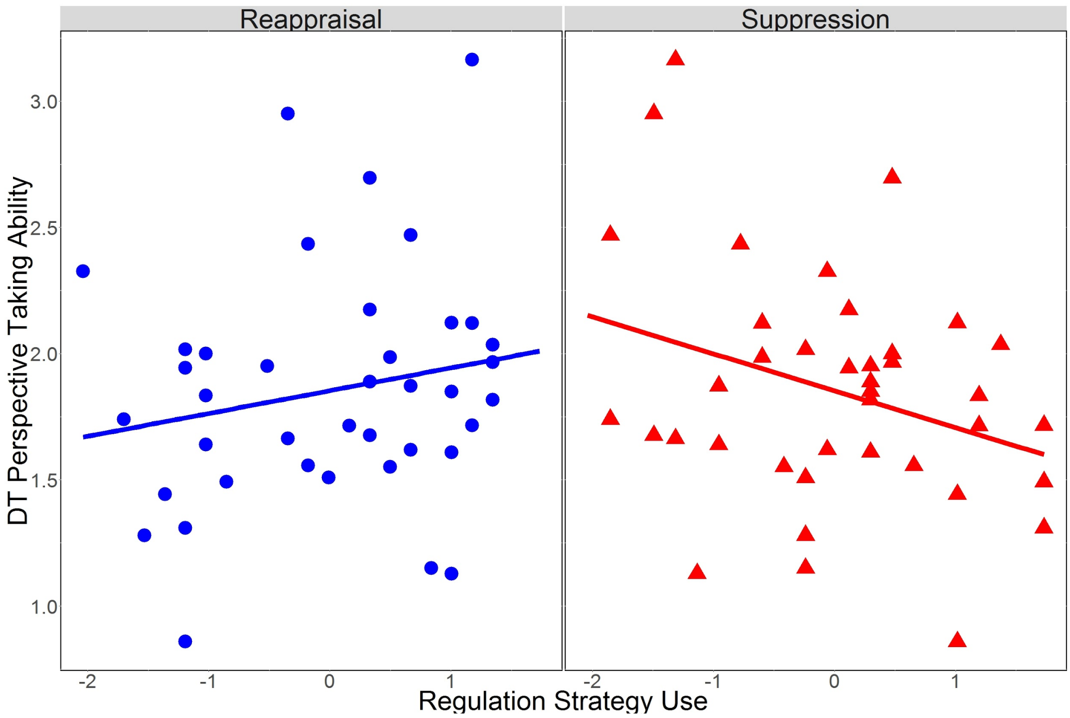

Fig. 3.6. Scatterplot showing the relationship between the director task perspective-taking metric and reappraisal/suppression use (ERQ).

3.3.2. RMET

Mean accuracy (± SD) on the RMET was 76.94% (±9.36%). As this task is a four-alternative forced-choice paradigm, an average score of 25% would be observed if participants were simply guessing. Accuracy equal to or greater than 50% indicates this is not the case and that participants were able to complete the task as instructed. Thus, the observed results suggest that participants were able to accurately attribute the correct descriptors to the depicted emotions at a level greater than chance.

RMET correlations with trait emotion dysregulation and strategy use

Mean RMET accuracy showed no relationship with DERS-Total, $r(38) = -.14$, $p = .40$. Similarly, RMET accuracy was not significantly related to the use of reappraisal ($rho(38) = .11$, $p = .51$) or suppression ($r(38) = -.16$, $p = .32$).

3.3.3. SFM task

A repeated measures ANOVA demonstrated that for the dependent variable ZM activity, there was no main effect of emotion, $F(1, 39) = .31$, $p = .58$, partial $\eta^2 = .01$, or epoch, $F(1, 39) = 1.34$, $p = .25$, partial $\eta^2 = .03$. The expected epoch by emotion interaction was significant, $F(1, 39) = 4.49$, $p = .04$, partial $\eta^2 = .10$. Pairwise comparisons with Bonferroni correction demonstrated that ZM activity was higher in the stimulus period relative to baseline for happy ($p = .04$) but not for angry ($p = .54$) faces. For illustrative purposes the mean baseline corrected ZM activity for each one-second epoch of the stimulus presentation are presented in figure 3.7.

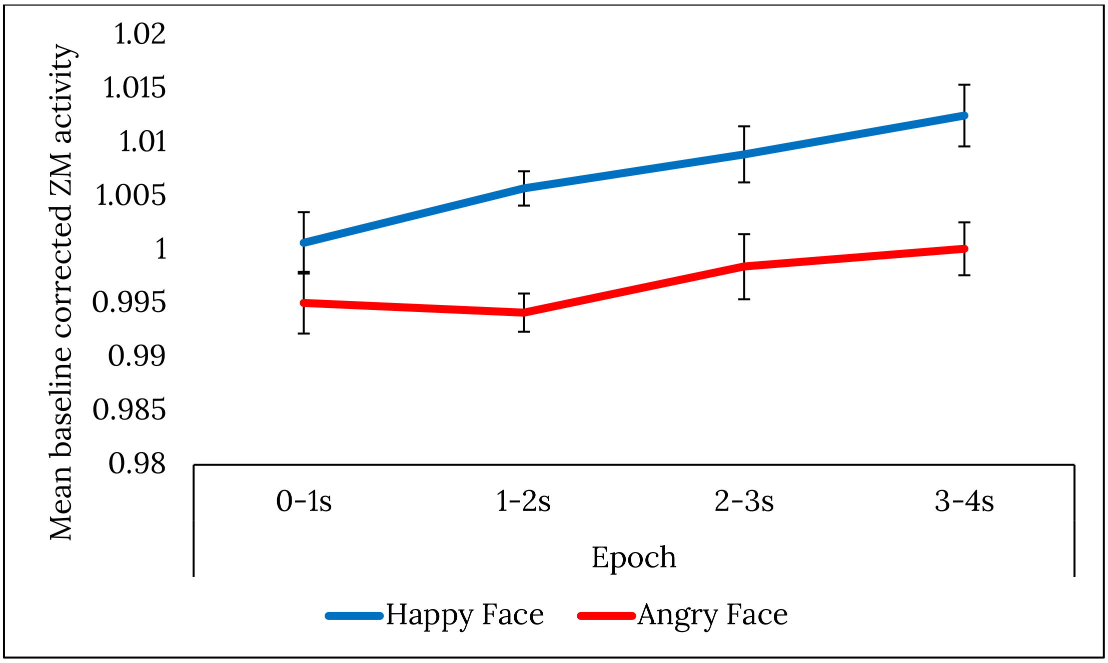

Fig. 3.7. Mean baseline-corrected ZM activity for happy and angry faces in each 1-second epoch during the stimulus presentation period. Error bars depict ± 1 within-subjects SEM.

For the dependent variable CS activity, there was a main effect of emotion, $F(1, 39) = 16.16$, $p < .001$, partial $\eta^2 = .29$, but no main effect of epoch, $F(1, 39) = .71$, $p = .40$, partial $\eta^2 = .02$. There was a significant emotion by epoch interaction, $F(1, 39) = 13.67$, $p = .001$, partial $\eta^2 = .26$. Post-hoc pairwise comparisons with Bonferroni correction showed that CS activity was higher for angry relative to happy faces overall ($p < .001$). For angry faces, CS activity was significantly higher in the stimulus period relative to baseline ($p = .001$). For happy faces, CS activity was significantly lower in the stimulus period relative to baseline ($p = .03$). For illustrative purposes, the mean baseline corrected CS activity for each one-second epoch during stimulus presentation are presented in figure 3.8.

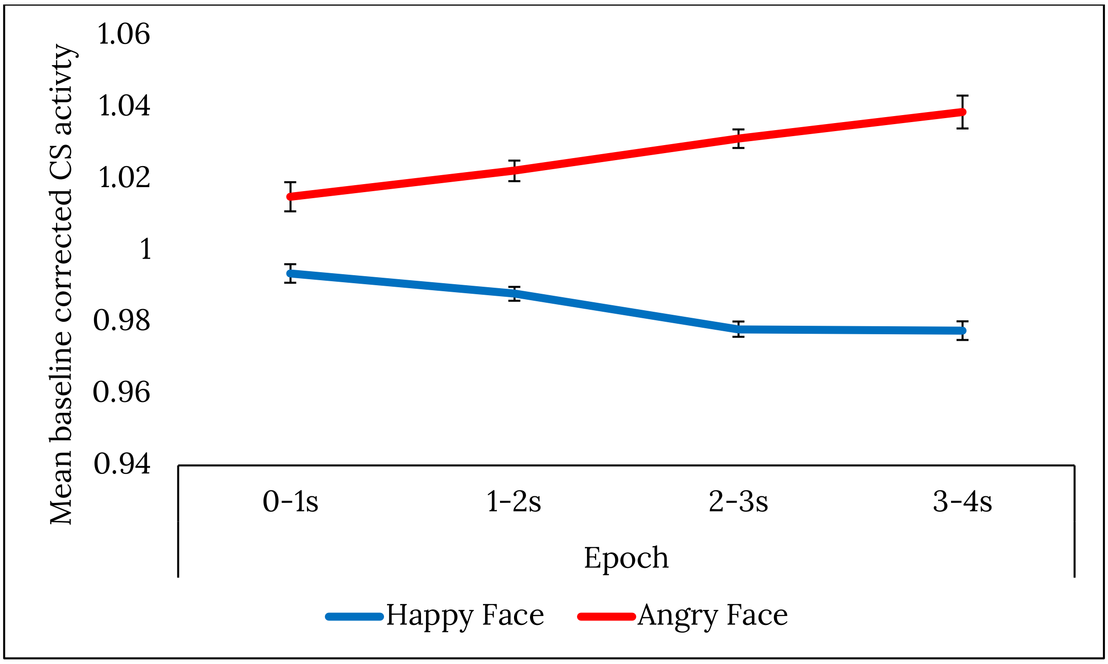

Fig. 3.8. Mean baseline-corrected corrugator activity for each 1-second epoch during stimulus presentation. Error bars depict ± 1 within-subjects SEM.

SFM task correlations with trait emotion dysregulation

Mean SFM (mean baseline corrected congruent muscle activity collapsed across happy and angry faces) showed a non-significant negative relationship with DERS-Total, *rho*(38) = -.26, *p* = .11. To better understand this unexpected result, the correlations between DERS-Total and mimicry of happy (ZM activation) and angry (CS activation) faces were examined individually. Happy face mimicry showed no relationship with DERS-Total, *rho*(38) = -.03, *p* = .84, however, mimicry of angry faces showed a large negative correlation with DERS-Total, *rho*(38) = -.47, *p* = .002. These two correlations were significantly different, Steiger's Z = 2.21, *p* = .03 (fig. 3.9).

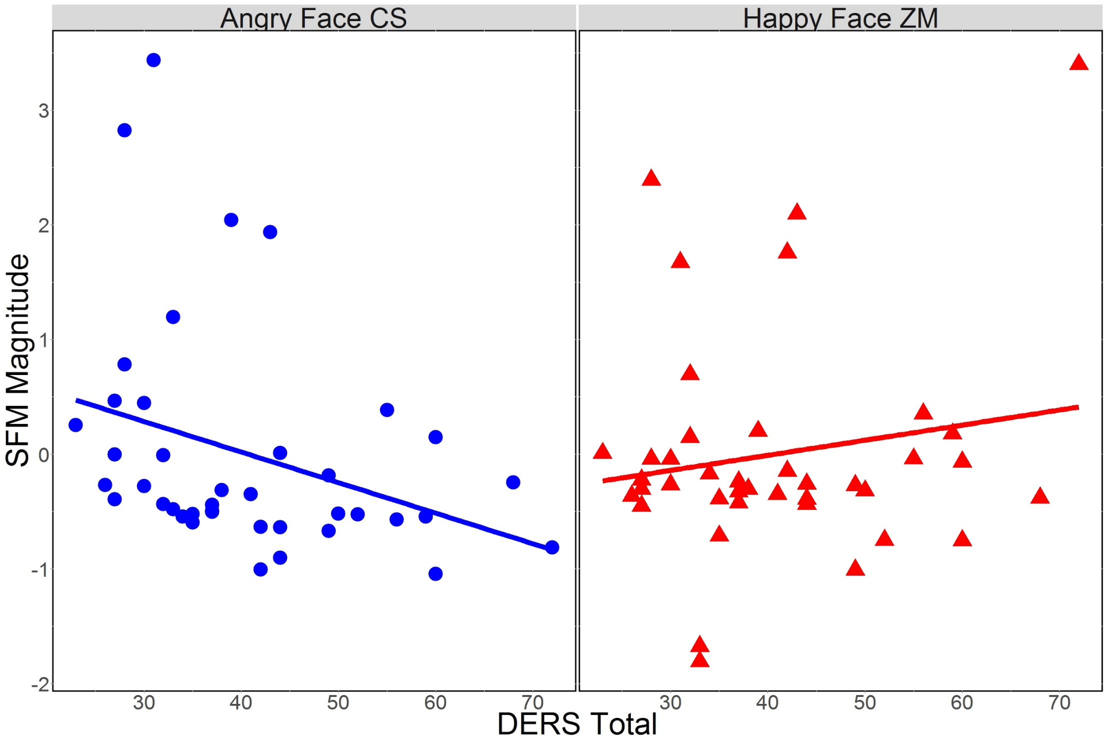

Fig. 3.9. Scatterplots showing the relationship between z-transformed mimicry of angry (baseline-corrected CS activity) and happy faces (baseline-corrected ZM activity) and DERS-Total. DERS-Total was negatively correlated with angry-face mimicry (blue) but was not significantly related to happy-face mimicry (red).

SFM *correlations with regulation strategy use*

Mean SFM magnitude was not significantly related to the use of reappraisal (*rho*(38) = .29, *p* = .07) or suppression (*rho*(38) = -.13, *p* = .44). Given the above findings demonstrating a different relationship with emotion dysregulation for mimicry of happy and angry faces, the relationship between happy and angry mimicry with reappraisal/suppression use were examined separately.

Happy face mimicry showed no relationship with reappraisal use (*rho*(38) = .04, *p* = .83), however, angry face mimicry was positively correlated with reappraisal use (*rho*(38) = .39, *p* = .01) (fig. 3.10). The difference between these two correlations was approaching significance (Steiger's Z = -1.78, p = .08). The use of suppression was not significantly related to mimicry of happy ($rho(38) = -.07$, $p = .69$) or angry ($rho(38) = -.19$, $p = .24$) faces. These correlations were not significantly different (Steiger's Z = -0.61, $p = .55$).

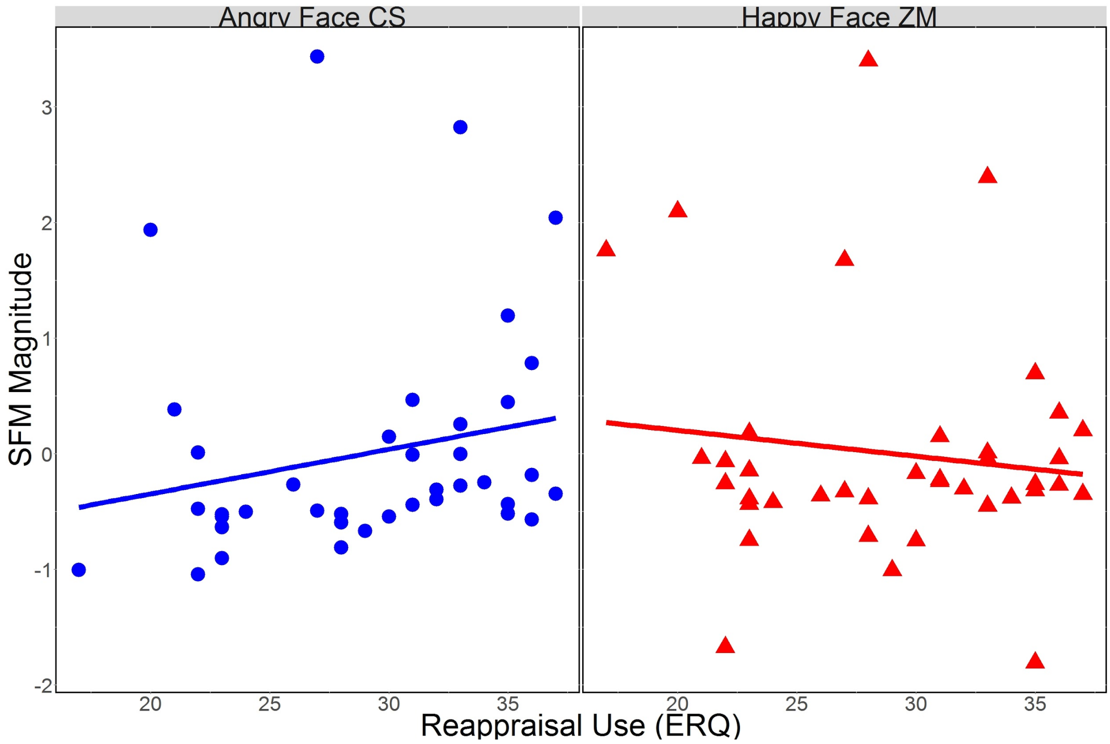

Fig. 3.10. Scatterplot showing the relationship between z-transformed mimicry of angry (baseline-corrected CS activity) and happy (baseline-corrected ZM activity) faces with reappraisal use (ERQ). Reappraisal use was positively correlated with angry mimicry (blue) but was not significantly related to happy mimicry (red).

3.3.4. Summary of results

Table 3.1. Correlations between empathy tasks and trait emotion regulation

Variable	DT	RMET	Angry SFM	Happy SFM
DERS-Total	-.49 (p = .002)	-.14 (p = .40)	-.47 (p = .002)	-.03 (p = .84)
Reappraisal (ERQ)	.21 (p = .21)	.11 (p = .51)	.39 (p = .01)	.04 (p = .83)
Suppression (ERQ)	-.31 (p = .06)	-.16 (p = .32)	-.19 (p = .24)	-.07 (p = .69)

3.4. Discussion

3.4.1. Summary of findings

This study examined the relationship between trait emotion regulation and task measures of different component processes related to empathy. Broadly speaking, the results support the hypothesis that different empathic processes share distinct relationships with emotion regulation.

Consistent with prior theoretical and empirical work suggesting that higher levels of cognitive empathy may support adaptive emotion regulation (e.g. Okun et al., 2000; Schipper and Petermann, 2013), a task measure of perspective-taking ability was negatively associated with trait emotion dysregulation as measured by the DERS (Kaufman et al., 2016). Perspective-taking ability was not significantly related to reappraisal use, as measured by the ERQ (Gross and John, 2003), however, the predicted negative relationship with suppression use was observed. Performance on a task assessing the ability to attribute complex mental/emotional states to targets based on images of the eye region showed no relationship with any measures of trait emotion regulation.

Contrary to the hypothesis that affective empathy would be positively related to emotion dysregulation, the magnitude of fEMG-measured SFM showed a trend-level negative correlation with trait emotion dysregulation. Follow-up analyses demonstrated that while mimicry of happy faces (indexed by increased ZM activity) showed no relationship with emotion dysregulation, mimicry of angry faces (indexed by increased CS activity) was negatively correlated with trait emotion dysregulation. Additionally, increased mimicry of angry, but not happy faces was associated with an increased tendency to use reappraisal but showed no relationship with self-reported use of suppression.

3.4.2. Cognitive empathy & emotion regulation

Through the use of multiple task measures that assess separable components of cognitive empathy, this study gives greater specificity to the relationship between cognitive empathy and emotion regulation. Perspective-taking ability was negatively associated with trait emotion dysregulation, suggesting that those with a greater capacity to take another's perspective experience fewer difficulties with emotion regulation. In contrast, the ability to infer a target's mental/emotional state based on images of the eye region showed no relationship with any trait measures of emotion regulation.

The different relationships that these two cognitive empathic abilities share with trait emotion regulation could be related to differences in the underlying processes by which they are mediated. A fundamental distinction between the processes recruited by these task measures is the extent to which they are reliant upon the 'online' control of self and other representations (Santiesteban et al., 2012). To perform well on the DT, participants must be able to represent the visual perspective of the director, and on experimental trials, quickly inhibit their own visual perspective in order to correctly identify the target object to which the director was referring. This egocentric suppression is largely mediated by inhibitory control processes, which enable the observer to switch between the co-active self and other representations (Bailey and Henry, 2008; Ruby and Decety, 2004; Santiesteban et al., 2012).

In contrast, the RMET is dependent upon one's ability to interpret subtle facial cues in order to attribute to the target a complex emotional/mental state. This ability is thought to rely upon the relatively automatic process of matching the perceived expressions to archetypes of emotional expressions and associated language stored in semantic memory, and unlike perspective-taking, does not necessitate the online switching between self and other representations (Baron-Cohen et al., 2001; Vellante et al., 2013).

Therefore, while both tasks assess abilities related to the cognitive component of empathy, the underlying mechanisms by which they are mediated differ in the extent to which they place demands on cognitive control processes (Bailey and Henry, 2008; Spengler et al., 2010). Given that many forms of adaptive emotion regulation are reliant upon similar cognitive control processes to those associated with perspective-taking (Buhle et al., 2014; Carlson et al., 2004; Dennis et al., 2009; Goldin et al., 2008; Hendricks and Buchanan, 2016; Saxe et al., 2004), it could be that individuals with a greater capacity for perspective-taking are able to engage these processes more efficiently, which facilitates the ability to regulate one's emotions. Such an interpretation could also explain why perspective-taking ability was negatively related to the use of suppression, as the greater regulatory capacity of individuals with improved perspective-taking abilities makes them less reliant upon potentially maladaptive strategies.

As the RMET does not recruit to the same extent the cognitive control processes that support emotion regulation, a greater ability to interpret others' emotional/mental states based on facial cues may confer little benefit in terms of regulating one's own emotions. It is important to note that the RMET assesses only the first stage of inferring another's mental/emotional state, which involves attributing an appropriate state to the other (e.g. embarrassed) but does not necessarily involve the later stage of inferring the content of that state (i.e. the cause of the target's embarrassment) (Baron-Cohen et al., 2001). Therefore, based on the results of this study, one can conclude only that there is no evidence that this first stage of mental state attribution is related to one's capacity for emotion regulation, and not that these inferential processes as a whole are unrelated to emotion regulation.

3.4.3. Affective empathy & emotion regulation

In contrast to cognitive empathic processes, the capacity to share others' emotions is largely mediated by more implicit mechanisms. For example, the predisposition to spontaneously mimic others' emotional displays, which can elicit an isomorphic affective state in the observer without the need for explicit cognitive processes (de Waal and Preston, 2017; Hatfield et al., 1993; Preston and de Waal 2002). The task measure of affective empathy used in the present study utilised fEMG to measure the extent to which participants spontaneously mimicked targets' emotional facial expressions, providing a proxy measure of their propensity to implicitly resonate with others' emotions (Dimberg et al., 2011; Hatfield et al., 1993; Sonnby-Borgstrom, 2002).

Consistent with prior work, the results suggest that the perception of emotional facial expressions elicits spontaneous activation in congruent facial muscles (Bornemann et al., 2012; Dimberg, 1990; Dimberg and Thunberg, 1998; Dimberg et al., 2000). Based upon evidence demonstrating the potentially deleterious effects of emotions on the efficiency of cognitive control processes (Hare et al., 2005, 2008; Tottenham et al., 2011) coupled with evidence that higher affective empathy is associated with heightened emotional reactivity (Rueckert et al., 2011; Sonnby-Borgstrom, 2002), it was predicted that SFM magnitude would be positively associated with levels of trait emotion dysregulation.

In contrast to this hypothesis, the mean magnitude of SFM (averaged across angry and happy faces) was not significantly related to trait emotion dysregulation. Furthermore, follow-up analyses revealed that a heightened propensity to mimic others' angry, but not happy, facial expressions was associated with lower levels of trait emotion dysregulation and an increased tendency to use adaptive reappraisal strategies. While these results were in contrast to the initial hypothesis, extant work does provide some precedent for these findings.

Prior work has shown that individuals who experience more negative emotions can exhibit deficits in spontaneous mimicry (Likowski et al. 2011). While negative affect was not explicitly measured in the present study, one could reasonably assume that individuals with greater levels of emotion dysregulation may be more prone to experiencing negative emotions than those with a greater capacity for regulation. Similarly, there is evidence that increased anxiety, often related to difficulties with emotion regulation (see Cisler et al., 2010 for review), is associated with reduced spontaneous mimicry (Vrijsen et al., 2010).

A study of children with disruptive behavioural disorders (DBD), for whom impairments in emotion/self-regulation are prevalent (Schoorl et al., 2016), demonstrated that relative to typical controls, those with DBD exhibited reduced mimicry of angry, but not happy, faces (de Wied et al., 2006). Similar valence-specific differences in processing emotional stimuli have been observed in other individuals for whom difficulties with emotion/self-regulation are common. For example, boys who display antisocial behaviour and conduct disorder show atypical processing of negative, but not positive, emotional stimuli (de Wied et al., 2009). The results of the present study are to some extent consistent with such findings and suggest that emotion dysregulation may be associated with valence-specific deficits in the propensity to mimic others' expressions of negative emotion.

When exposed to a conspecific displaying an angry facial expression with direct eye contact, one's initial response to the potential threat inherent in such stimuli (Kleinke, 1986) could be a defensive 'freezing' reaction (Ardizzi et al., 2013). Indeed, it has been proposed that fight, flight, and freeze systems are important mediators of one's reaction to potentially aversive/threatening stimuli (Gray and McNaughton, 2000). A freeze response is thought to occur upon perception of a threatening stimulus and disrupts action in service of prioritising resources in order to deal with the potential threat (Algom et al., 2004; McKenna and Sharma, 2004).

The reduced mimicry of angry facial expressions observed in individuals with higher levels of emotion dysregulation could be related to a heightened propensity to exhibit an automatic freezing response, which results in inhibited facial muscle activity for angry, but not happy faces. It is also possible that individuals with a greater capacity for emotion regulation are better able to implicitly regulate these early automatic responses and thus, exhibit greater mimicry of angry expressions than those with less well-regulated responses. Similarly, one could speculate that SFM of angry faces might include some degree of cognitive processing associated with determining whether the perceived other is a friend/foe or more/less dominant (Wang and Hamilton, 2012). Given that such cognitive processes would be unlikely to occur in the instance of non-threatening happy facial expressions, such an interpretation could potentially explain the results observed in the present study.

It is important to consider the possibility that the observed effects were not driven solely by deficits in mimicry/embodiment processes per se but could also be a reflection of variability in the way in which individuals with higher/lower levels of emotion dysregulation attended to the stimuli. While SFM reflects a relatively automatic and implicit response, it is sensitive to modulation by attentional processes. For example, the magnitude of SFM is increased when individuals have a greater motivation to attend to the emotional features of faces, such as when explicitly instructed to infer the emotional state of depicted targets (Murata et al., 2016). Additionally, activations in brain regions associated with mimicry/embodiment are greater when participants are induced to focus upon the eye region of the face (Hadjikhani et al., 2017). In line with these findings, it is possible that individuals with higher levels of emotion dysregulation were less willing/able to maintain direct contact with the threatening angry faces, which may have reduced the extent to which they exhibited SFM for these expressions.

Finally, it was predicted that SFM magnitude would be negatively related to the use of suppression. However, this study found no evidence for a significant relationship between any SFM metrics and the habitual use of suppression. It is possible that individuals who use suppression regularly are more likely to do so only in instances where their emotional response exceeds a certain threshold in intensity. Given that the face stimuli used in the current SFM task were unlikely to elicit emotion of a particularly high intensity, it could be that even those who frequently use suppression in their daily lives were no more likely than others to use this strategy during the task. This could explain why SFM showed no relationship with the habitual use of suppression.

3.4.4. Summary, conclusions, and limitations

The results of this study provide new evidence regarding the relationship between cognitive/affective empathy and emotion regulation. By utilising two task measures that assess different abilities relevant to the cognitive component of empathy, this study provides greater specificity regarding the relationship between this dimension of empathy and emotion regulation. Consistent with the results of the trait analysis reported in chapter 2, perspective-taking ability was positively related to adaptive emotion regulation. However, the ability to attribute complex emotional/mental states to targets based on subtle facial cues showed no relationship with measures of trait emotion regulation. Using a task measure of affective empathy (based on SFM), it was observed that mimicry of angry, but not happy, faces was associated with more adaptive emotion regulation.

While the studies reported thus far have utilised a combination of trait and task measures of empathy, emotion regulation has been assessed using only trait measures, which may not necessarily provide an accurate reflection of respondents' regulatory abilities. Subsequent chapters seek to build upon these studies by using more objective task-based measures of different emotion regulation abilities. The next chapter examines the relationship between trait empathy and behavioural tasks that assess implicit emotion regulation abilities.

Chapter 4

Trait empathy and task measures of implicit emotion regulation

4.1. Introduction

The studies reported in prior chapters broadly support the hypothesis that the cognitive and affective dimensions of empathy are differentially related to emotion regulation. The trait analysis reported in chapter 2 highlights specific points of divergence between cognitive and affective empathy in terms of their relationship with subscales measuring difficulties with impulse control and maintaining focus on goal-directed behaviours in emotional situations. These abilities are largely dependent on implicit regulatory processes; consequently, the study reported in this chapter examines how these components of trait empathy are associated with performance on two behavioural tasks that assess implicit emotion regulation abilities.

4.1.1. Implicit emotion regulation

Implicit emotion regulation encompasses various regulatory processes that can occur automatically with little or no reliance upon conscious effortful control. Such processes may be enacted automatically in response to an emotional stimulus, running to completion without the need for any explicit regulation intentions or conscious monitoring (Gyurak et al., 2011; Mauss et al., 2007). Implicit emotion regulation can entail the spontaneous implementation of what are often deemed more explicit regulatory strategies, such as reappraisal, which may be enacted without conscious intent or awareness (Yuan et al., 2015). In this study, the focus is upon implicit regulatory processes that occur at the earliest stages of exposure to an emotional stimulus.

The capacity for emotional stimuli to capture attention in an automatic fashion is well documented (Buschman and Miller, 2007; Carretié, 2014; Öhman et al., 2001). This prioritised attentional orienting is likely mediated by automatic activations in subcortical regions associated with emotional processing, such as the amygdala, which show increased activity in response to emotional stimuli (Breiter et al., 1996; Gamer and Büchel, 2009; Garavan et al., 2001; Killgore and Yurgelun-Todd, 2001; Monk et al., 2003; Whalen et al., 1998).

Prioritised processing of emotional information is in many ways adaptive, particularly in the case of negatively valenced stimuli which could represent a potential threat that should be attended (Hansen and Hansen, 1988; Öhman et al., 2001; Schimmack and Derryberry, 2005). However, there are many instances in which emotional stimuli are entirely irrelevant to one's survival or current goals and represent little more than an unhelpful distraction. Attention reflects a limited capacity system (Kahneman, 1973), and irrelevant emotional distractors may consume the cognitive resources critical for the successful enactment of goal-oriented behaviours. Indeed, prior work highlights the potentially deleterious impact emotional stimuli can have on cognitive control processes (Hare et al., 2005; Jasinska et al., 2012; Padmala et al., 2011; Reeck and Egner, 2011; Tottenham et al., 2011).

Given the fast and spontaneous onset of affective responses, coupled with the high frequency with which one may encounter emotion-inducing stimuli in daily life, the capacity to adaptively regulate the early influence of emotional stimuli/experiences on cognitive control processes is crucial for effective social/cognitive functioning (Blair et al., 2007; Campos et al., 2004; Etkin et al., 2006) and the completion of goal-oriented behaviours (Blair et al., 2007; Taylor and Fragopanagos, 2005).

Evidence suggests that deficits in implicit emotion regulation, such as reduced efficiency in disengaging attention from distracting task-irrelevant emotional stimuli, are associated with increased risk for the development and maintenance of emotion dysregulation and various disorders of affect (Olafsson et al., 2011; Olatunji et al., 2011; Rive et al., 2013). Furthermore, as many explicit regulation processes are reliant upon the efficient action of cognitive control mechanisms (Buhle et al., 2014; Goldin et al., 2008; Hendricks and Buchanan, 2016; Kalisch, 2009; McRae et al., 2012), deficits in early implicit regulatory processes could impact one's capacity to utilise adaptive regulation strategies at a later stage in the emotion generation process (Koster et al., 2011; Morillas-Romero et al., 2015). Thus, it is possible that the different relationships that cognitive and affective empathy share with emotion dysregulation and habitual strategy use are to some extent a reflection of differences in implicit emotion regulation abilities.

4.1.2. Task measures of implicit emotion regulation

A common approach for assessing implicit emotion regulation abilities involves cognitive control tasks wherein performance is compared across conditions in which distracting stimuli are either emotional or non-emotional. Such tasks provide a measure of the extent to which cognitive performance is disrupted by emotional information and are based on the assertion that individuals with greater implicit emotion regulation abilities exhibit reduced emotional interference effects (Etkin et al., 2010; Jackson et al., 2003; Koole and Rothermund, 2011; Zhang and Lu, 2012).

While the term implicit is sometimes used only in reference to paradigms where the processing of emotional information is entirely irrelevant to task performance (Zhang and Lu, 2012), in alignment with Yiend et al. (2008), here the term is used more broadly to refer to tasks in which regulatory processes may be initiated without any explicit instruction or overt intention. In the following subsections, I discuss two paradigms commonly used to assess implicit emotion regulation: The emotional go/nogo (henceforth Emo-GNG) and the emotional Stroop (henceforth Emo-Stroop).

4.1.3. Emo-GNG

The go/nogo is a psychomotor task in which participants must respond rapidly to targets (go stimuli) while withholding responses to non-targets (nogo stimuli) (Rueda et al., 2005). Stimuli are presented in quick succession, with the task structure weighted in favour of go trials (typically ~75% of trials) in order to induce a prepotent tendency to respond, which must then be inhibited on nogo trials. The go/nogo is considered a reliable measure of response inhibition/behavioural impulsivity, which is indexed by false alarm rate (FAR; i.e. the proportion of nogo trials in which the participant failed to inhibit their response) (Rueda et al., 2005; Tottenham et al., 2011). The Emo-GNG task utilises the same structure but with the addition of emotional and neutral stimuli, which enables the assessment of the extent to which emotional information impacts inhibitory control processes (Albert et al., 2010; Blair et al., 2007; Hare et al., 2005; Tottenham et al., 2011). This task has previously been used to assess variability in implicit emotion regulation abilities in both clinical and typical populations (Hare et al., 2005, 2008; Tottenham et al., 2011; Zhang et al., 2016).

Prior studies have demonstrated that emotional nogo stimuli induce a higher FAR relative to neutral nogo stimuli (e.g. Hare et al., 2005; Tottenham et al., 2011). Additionally, some studies have shown that positively valenced nogo stimuli are associated with increased FAR relative to negatively valenced nogos (Hare et al., 2005; though see Tottenham et al., 2011), which is typically attributed to the different approach/avoid tendencies that these positively/negatively valenced stimuli elicit (Chen and Bargh 1999; Marsh et al. 2005; O'Doherty et al., 2003). In addition to FAR it is important to consider participants' hit rate (HR), which reflects their accuracy in responding on go trials. D-prime provides a more holistic measure of Emo-GNG performance as it enables the assessment of FAR accounting for HR (Tottenham et al., 2011).

4.1.4. Emo-Stroop

The standard version of the Stroop requires participants to respond to the perceptual features of a stimulus (e.g. the colour in which a word is written) while ignoring an irrelevant semantic dimension (e.g. the meaning of the word), which is either congruent or incongruent with the target dimension (Stroop, 1935). An increase in mean response times (RT) for incongruent relative to congruent trials has been consistently reported (see review by MacLeod, 1991).

Numerous emotional variants of the Stroop have been used to assess biased attentional processing and the interaction between emotion and cognition. With reference to the current study, Emo-Stroop tasks have also proven useful in assessing implicit emotion regulation (see review by Buhle et al., 2010). Some emotional variants of the Stroop involve testing performance on a standard Stroop task following exposure to emotional and neutral stimuli (e.g. Hart et al., 2010), others involve comparing speed and accuracy in responding to the colour of emotional and neutral words (Whalen et al., 1998; Richards et al., 1992; Mackay et al., 2004). Many of these Emo-Stroop variants have demonstrated the potential for emotional stimuli to disrupt cognitive control processes relative to neutral stimuli (Etkin et al., 2006; Haas et al., 2006). However, other studies have found evidence of Emo-

Stroop interference effects only in individuals with high trait anxiety (e.g. Kalanthroff et al., 2015; Richards et al., 1992; see also Buhle et al., 2010). Here I focus upon a particular version of the Emo-Stroop, commonly referred to as the word-face Stroop.

The word-face Stroop stimuli consists of an emotional facial expression overlaid with a word, which is either congruent or incongruent with the face in terms of the categorical emotion (e.g. Egner et al., 2008; Etkin et al., 2006; Strand et al., 2013; Zhu et al., 2010) and/or valence (e.g. Basgoze, 2015; Haas et al., 2006; Stenberg et al., 1998; Strand et al., 2013). The word-face Stroop is a 2-AFC response task in which participants must categorise a target (e.g. as positive or negative) while ignoring an irrelevant distractor dimension. In some paradigms the target is the face (with the word as a distractor; Egner et al., 2008; Etkin et al., 2006; Hu et al., 2012; Strand et al., 2013; Zhu et al., 2010), whereas in others, the word is the target (with the face as a distractor; Başgöze, 2015; Haas et al., 2006; Stenberg et al., 1998; Strand et al., 2013; Zhu et al., 2010).

Using various versions of the word-face Stroop, prior studies have demonstrated increased RT on incongruent relative to congruent trials (Etkin et al., 2006; Haas et al., 2006). Given evidence of the automatic processing of both words and faces, such findings are interpreted as demonstrating that an irrelevant emotional stimulus can spontaneously activate associated semantic representations, which interferes with the processing of incongruent targets and/or facilitates processing of congruent targets (Stenberg et al., 1998).

4.1.5. The current study

It is possible that the different relationships that cognitive and affective empathy share with trait emotion regulation reported in previous chapters are a reflection of differences in implicit emotion regulation abilities. For example, the greater use of adaptive reappraisal strategies and reduced difficulties with impulse control observed in individuals with higher trait cognitive empathy, could be a reflection of a heightened capacity for implicit regulatory processes. One prior study provides some support for this assertion, by demonstrating that performance on a cognitive empathy/ToM task was associated with increased ability to ignore irrelevant distractors in an Emo-Stroop task (Bradford 2015). However, this study did not examine the relationship that affective empathy shared with this task.

Higher affective empathy entails increased reactivity to others' emotions (Sonnby-Borgstrom, 2002), which could have a deleterious effect on critical cognitive control processes (Tottenham et al., 2011). A reduced capacity to implicitly regulate such emotional interference could explain the positive relationship between affective empathy and self-reported difficulties in managing emotions and maintaining a focus on goal-oriented behaviours reported in chapter 2. Indeed, prior work has shown that affective empathy is associated with a heightened sensitivity to emotional stimuli, such as in attentional blink tasks (Kanske et al., 2013). Conversely, in a study using an Emo-Stroop variant it was found that trait empathy, as measured by the QMEE (Mehrabian and Epstein, 1972) and the IRI (Davis, 1983), showed no relationship with the magnitude of Stroop incongruency effects (Hofelich and Preston, 2012).

However, the trait measures used in this prior study may lack sufficient precision to assess the cognitive and affective dimensions of empathy without conflating them with related but dissociable constructs, such as sympathy (Reniers et al., 2011). A further limitation of many previous word-face Stroop tasks is the lack of an appropriate control condition, which makes it difficult to determine the extent to which the RT difference between congruent and incongruent conditions is driven by interference (on incongruent trials) or facilitation (on congruent trials). Accordingly, the current study includes a neutral control condition to enable the separation of emotional interference and facilitation effects.

To better understand the divergent relationships that cognitive and affective empathy share with measures of trait emotion regulation, this study examined how these dimensions of empathy are related to implicit emotion regulation abilities. To this end, an Emo-GNG and Emo-Stroop task were used to assess participants' ability to maintain effective cognitive control in the presence of salient emotional distractors. Given evidence of their ability to evoke affective responses in an automatic fashion, human facial expressions of emotion were used as stimuli (Breiter et al., 1996; Killgore and Yurgelun-Todd, 2001; Morris et al., 1996; Whalen et al., 1998; Hare et al., 2005). As prior work has demonstrated the potential for both positively and negatively valenced stimuli to attract attention and disrupt cognitive processing (Hare et al., 2005; Pratto and John, 1991), both tasks included positive, negative, and neutral facial expressions in order to increase the generalisability of the results.

It was predicted that emotional stimuli would disrupt inhibitory control processes, as indexed by (1) lower D-prime for emotional nogo relative to neutral nogo trials in the Emo-GNG, and (2) increased RT for incongruent relative to neutral control trials in the Emo-Stroop. Critically, it was predicted that trait cognitive and affective empathy would be differentially related to the magnitude of these emotion interference effects. Greater cognitive empathy would be associated with reduced emotional interference and greater affective empathy associated with increased emotional interference. A summary of the hypotheses is presented below.

1) *D-prime will be lower for the emo-nogo relative to the calm-nogo condition. It is predicted that this emotional interference effect will be negatively related to cognitive empathy and positively related to affective empathy.*

2) *Emo-Stroop RT will be shorter for congruent trials and longer for incongruent trials, relative to a neutral control condition. It is predicted that the emotion interference effect will be negatively related to cognitive empathy and positively related to affective empathy.*

4.2. Emo-GNG task

4.2.1. Participants

Based on a correlation of .29 between affective empathy and the DERS goals subscale reported in chapter 2, an a priori sample size estimation using G*Power 3.1. (Faul et al., 2007) suggested a minimum sample of 72 was required to detect small to moderate effects at an alpha level of p = .05, with power of .80. Ninety-two right handed participants (78 females) were recruited from the undergraduate psychology population at the UOR. All participants completed the Emo-GNG and Emo-Stroop tasks. Participants were recruited through the online research panel and received course credit for participation. The mean age (±*SD*) was 19.86 (±2.39). Following data quality checks, 13 participants were removed from the Emo-GNG task (see *data reduction and analyses* section for details), leaving a final sample of N = 79 (68 females; mean age ± *SD* = 19.93 ± 2.61), which was subject to analysis. The QCAE was completed by all participants (see section 2.2.1.2. for further details of this measure). Cronbach's alpha was high for both QCAE subscales ($\alpha_{\text{Affective Empathy}}$ = .79; $\alpha_{\text{Cognitive Empathy}}$ = .88).

4.2.2. Materials

Face stimuli were taken from the Nimstim Face Stimulus Set (Tottenham et al., 2012; www.macbrain.org) and comprised photographs of six female (identity numbers: 1, 3, 6, 8, 9, 10) and six male actors (identity numbers: 21, 22, 23, 24, 28, 34). Different male and female actors displaying facial expressions of fear were used for the practice block (identity numbers: 2, 7, 14, 16, 20, 37, 38, 42). Each image was converted to grey-scale with dimensions of 256 x 329 pixels. The facial expressions included in the task were the closed mouth versions of happy, sad, disgusted, and calm (i.e. neutral). These emotions were selected in order to include stimuli depicting expressions of positive, neutral, and negative valence, which were likely to differ in terms of the approach/avoid tendencies they elicit. The same actors were used for each facial expression, and the frequency with which each stimulus was presented was balanced across conditions.

4.2.3. Procedure

Participants completed the Emo-GNG and Emo-Stroop within the same session; the order of task completion was counterbalanced across the sample. The Emo-GNG task lasted approximately 25 minutes. This included a practice block comprising 12 trials, followed by 6 experimental blocks each comprising 48 trials. An emotional target (go) or distractor (nogo) was always paired with a calm target/distractor, such that if an emotional face was the go stimulus, a calm face was the nogo stimulus, and vice versa. To induce a prepotent tendency to respond, 73% (N = 35) of the trials in each block were go trials, and 27% (N = 13) were nogo trials. Trial frequencies within each block are presented in table 4.1 and a schematic of the trial structure is depicted in figure 4.1. The order in which the different experimental blocks were completed was randomised.

Table 4.1. Block structure and number of trials in the Emo-GNG task

Go Stimulus (trial N)	No-Go Stimulus (trial N)
Happy (35)	Calm (13)
Sad (35)	Calm (13)
Disgust (35)	Calm (13)
Calm (35)	Happy (13)
Calm (35)	Sad (13)
Calm (35)	Disgust (13)

At the start of each block, participants were told which emotion represented the go stimulus and were instructed to respond to these targets by pressing ‘0’ on the keypad with their right index finger. Participants were not told what the nogo expression would be but were instructed to respond only to the target expression and withhold responding for any other expression. The instructions were to respond as quickly as possible to go targets while maintaining accuracy (see appendix F for full instructions).

Stimuli were presented in the centre of the screen for 500 ms at a size of 7.2cm wide 9.2cm high. A white fixation cross positioned centrally atop a black background was presented during each interstimulus interval (ISI), which was jittered, ranging from 2000 ms - 6000 ms (*M*±*SD* = 3708ms ± 1211ms). Following the onset of a stimulus there was a 2000 ms window in which responses were recorded (go trials in which a response was not made within this time window were classed as misses). As in previous Emo-GNG tasks (Durston et al., 2002; Hare et al., 2005), trial order was pseudorandom and parametrically balanced to control for the number of go stimuli preceding each nogo stimulus and to ensure that nogo trials occurred equally across the early, middle, and late stages of a block. Upon completion of a block a holding screen was presented until participants pressed a key to continue.

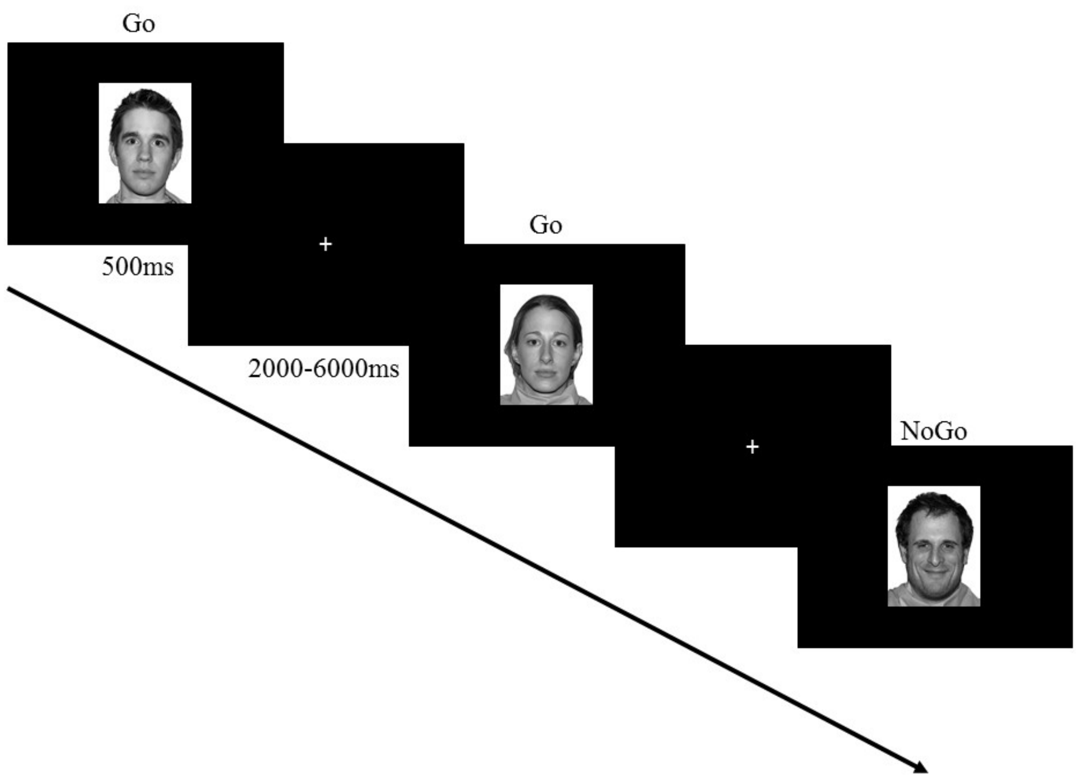

Fig. 4.1. Schematic of the Emo-GNG task events. This example shows three trials in the calm-happy block; participants must respond as quickly as possible to frequent go (neutral) faces while withholding responses to infrequent nogo (happy) faces.

4.2.4. Data reduction and analyses

Participants with a mean HR or FAR that deviated from the group mean by more than 3*SD were removed as outliers (12 participants). Visual inspection of these data confirmed that these participants had failed to properly follow task instructions in at least one block (e.g. they always/never responded on every trial and/or confused the go/nogo stimuli). Further, one participant was removed as the necessary questionnaire data was incomplete, leaving a final sample of N = 79, which was subject to analysis.

The key index of task performance on the Emo-GNG was D-prime, which was calculated by subtracting the z-transformed FAR from the z-transformed HR. As D-prime calculations cannot be performed for values of 1 (i.e. 100% HR/FAR) or 0 (i.e. 0% HR/FAR), any such values were transformed using the formula: 1/(2N) for values of 0, and 1-1/(2N) for values of 1. D-prime data were analysed using a repeated measures ANOVA with trial type (Emo-NoGo/Calm-NoGo) and emotion (happy, sad, disgust) as within-subjects factors. Greenhouse Geisser corrected values are reported where the assumption of sphericity was not satisfied.

The key metric extracted from this task for the correlation analysis was the difference in mean D-prime between the calm-nogo and emo-nogo conditions (CalmNoGo D-prime - EmoNoGo D-prime). This metric was termed the ‘emotion interference effect’. As the different facial expression pairings were balanced across these two conditions, this metric controls for variability in participants' capacity to discriminate between the calm and emotional faces, providing a measure of the extent to which performance was affected by emotional nogo stimuli.

Bivariate correlations were used to examine the relationship between trait cognitive/affective empathy and the emotion interference effect. Normality of each variable was assessed using Kolmogorov Smirnov tests. Spearman's rho is reported for correlations where any variable distribution showed significant deviation from normality. To ensure that the observed results were not unduly influenced by a small number of outlier cases, the same analyses reported in the results section were conducted following the removal of univariate and bivariate outlier cases (see appendix F). Furthermore, while not related to the primary aims of this study, the relationship between the Emo-GNG, Emo-Stroop, and ERQ were examined (see appendix F).

4.2.5. Results

A repeated measures ANOVA demonstrated a significant main effect of target, $F(1, 78) = 96.60$, $p < .001$, partial $\eta^2 = .55$, and emotion, $F(1.83, 142.88) = 70.91$, $p < .001$, partial $\eta^2 = .48$. A significant target by emotion interaction was also observed, $F(2, 156) = 32.52$, $p < .001$, partial $\eta^2 = .29$.

Effects of target condition

Post-hoc pairwise comparisons with Bonferroni adjustment revealed that D-prime was significantly higher for calm (M ± SD = 2.76 ± 0.51) relative to emotional (M ± SD = 2.19 ± 0.07) nogo stimuli (p < .001) (fig. 4.2, left panel). Regardless of the emotion, D-prime was always higher for blocks where the nogo stimulus was a calm face: Disgust (calm-nogo M ± SD = 3.09 ± 0.57; emo-nogo M ± SD = 2.72 ± 0.72, $p < .001$), happy (calm-nogo M ± SD = 2.92 ± 0.61; emo-nogo M ± SD = 1.83 ± 0.94, $p < .001$), sad (calm-nogo M ± SD = 2.27 ± 0.72; emo-nogo M ± SD = 2.01 ± 0.67 $p = .003$) (fig. 4.2, right panel).

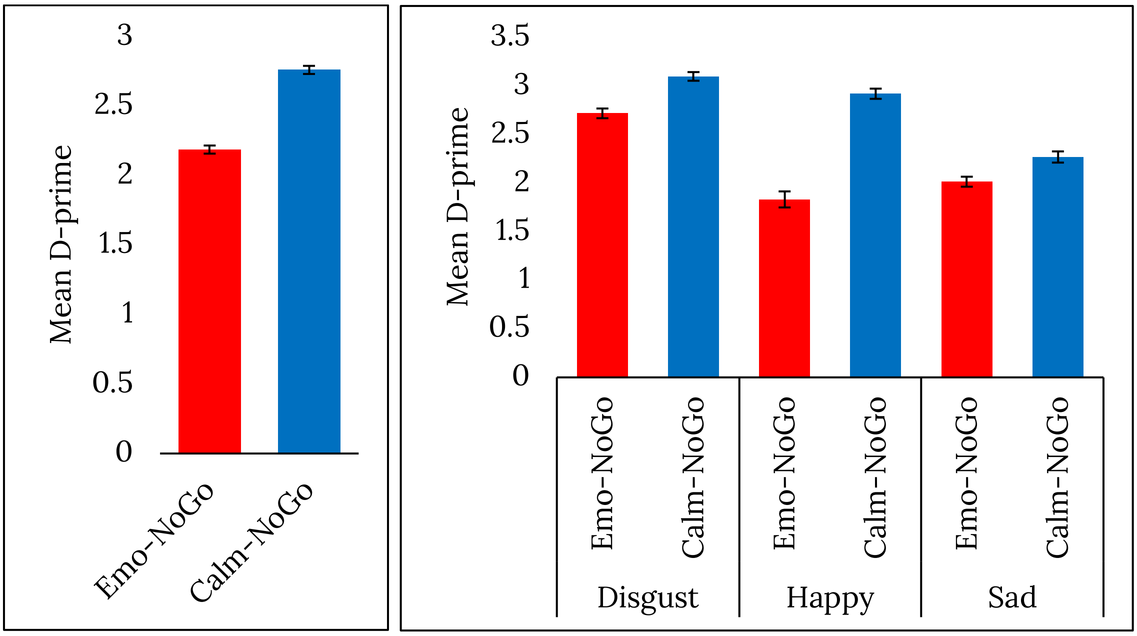

Fig. 4.2. Mean D-prime for Emo-NoGo and Calm-NoGo conditions on the left. Mean D-prime for Emo-NoGo and Calm-NoGo trials for each emotion condition on the right. Error bars depict ± 1 within-subjects SEM.

Effects of emotion and interaction with target condition

Regardless of whether the nogo stimulus was calm or emotional, D-prime was higher for disgust (M ± SD = 2.91 ± 0.58) relative to happy (M ± SD = 2.37

± 0.63, $p < .001$) and sad (M ± SD = 2.14 ± 0.59, $p < .001$). D-prime for happy blocks was higher than for sad ($p = .004$). To better understand the target by emotion interaction and whether the specific emotion had an influence on task performance, the D-prime difference (calm-nogo minus emo-nogo conditions) was compared across emotions. This metric reflects differences in the degree of interference for emo-nogo stimuli while controlling for any variability in the discriminability between the emotional and the calm faces. Bonferroni adjusted pairwise comparisons revealed that the difference between the calm-nogo and emo-nogo conditions was greater for happy faces (M ± SD = 1.09 ± 0.96) relative to disgust (M ± SD = 0.38 ± 0.56) ($p < .001$), and sad (M ± SD = 0.25 ± .75) ($p < .001$). There was no difference between the disgust and sad conditions ($p = .66$).

Emo-GNG emotion interference effect correlations with trait empathy

Trait affective empathy was positively correlated with the GNG emotion interference effect, $r(77) = .34$, $p = .003$. Cognitive empathy was not significantly related to the GNG emotion interference effect, *rho*(77) = .14, $p = .22$. The difference between these correlations did not reach significance, Steiger's Z = -1.58, $p = .11$. (fig. 4.3).

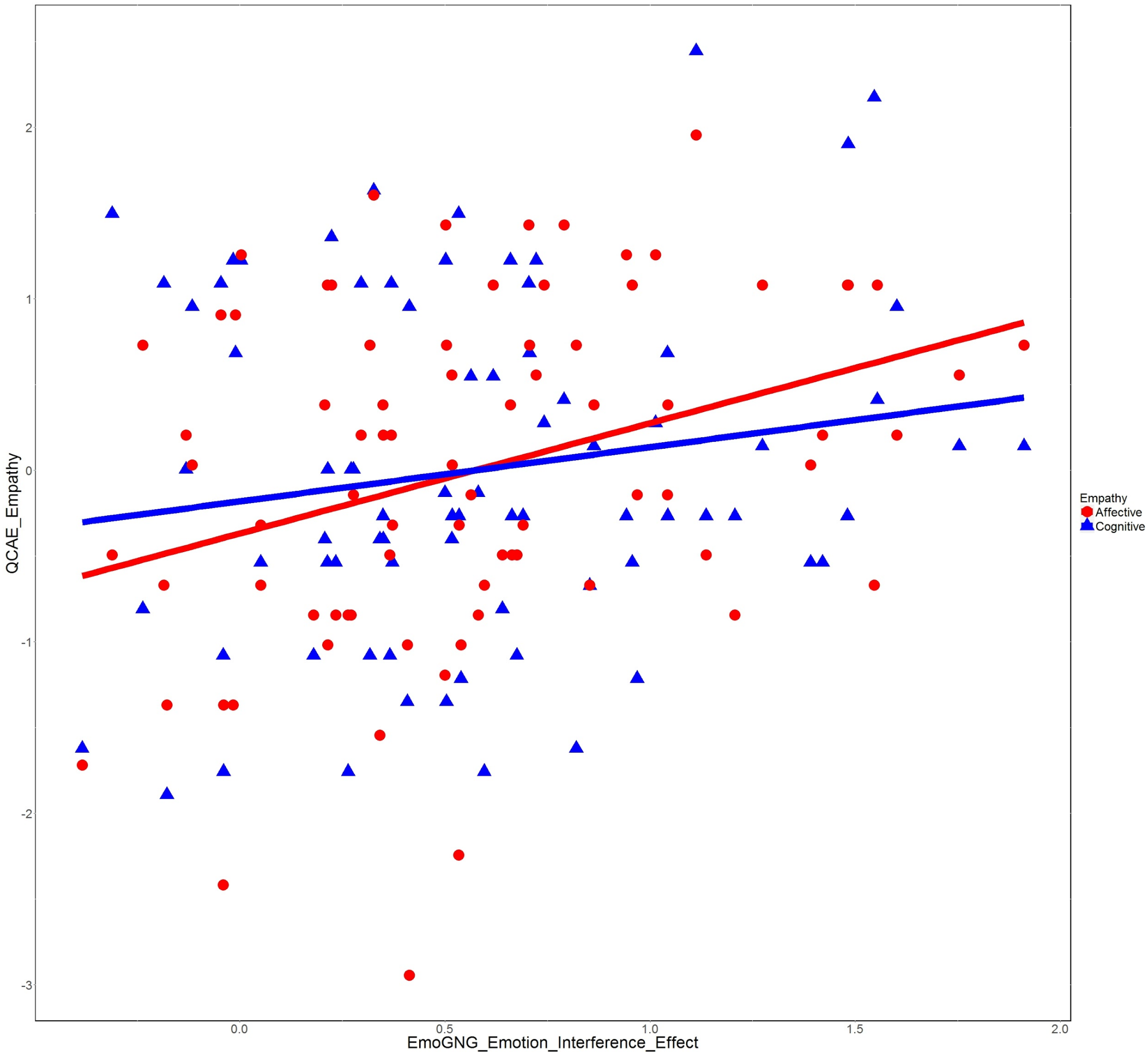

Fig. 4.3. Scatterplot showing the relationship between z-transformed cognitive/affective empathy and the GNG task emotion interference effect (calm-nogo D-prime minus emo-nogo D-prime). Affective empathy (red) showed a significant positive correlation with the emotion interference effect; cognitive empathy (blue) was not significantly related to the emotion interference effect.

Given that affective empathy has been found to be associated with improved emotion discrimination under conditions of brief stimulus exposure (Kang et al., 2017), it is possible that the correlation between affective empathy and the emotion interference effect could have been driven by a higher D-prime in the calm-nogo condition (i.e. improved HR when responding to emotional go targets).

To test whether the observed correlation between affective empathy and the emotion interference effect may have been driven by an increased performance in the calm-nogo (emo-go) condition, rather than increased interference in the emo-nogo condition, the relationship between affective/cognitive empathy and D-prime in the calm-nogo and emo-nogo conditions were examined individually.

A negative correlation between affective empathy and D-prime in the emo-nogo condition was on the threshold of significance, $r(77) = -.22$, $p = .05$. Affective empathy showed no relationship with D-prime in the calm-nogo condition, $r(77) = .08$, $p = .50$. These results suggest that the correlation between affective empathy and the emotion interference effect was driven by increased emotional interference in the emo-nogo condition, rather than improved performance in the calm-nogo condition. Cognitive empathy was not significantly related to D-prime in either the emo-nogo, $rho(77) = -.13$, $p = .26$, or calm-nogo condition, $rho(77) = -.02$, $p = .90$.

4.3. Emo-Stroop task

4.3.1. Participants

The same 92 participants who completed the Emo-GNG task also completed the Emo-Stroop. Nine participants were removed following data quality checks (see *data reduction and analyses* section for details), leaving a final sample of N = 83 (69 female; mean age ± *SD* = 19.93 ± 2.50), which was subject to analysis. Cronbach's alpha for both dimensions of the QCAE were high within this sample ($\alpha_{\text{Affective Empathy}}$ = .83; $\alpha_{\text{Cognitive Empathy}}$ = .90).

4.3.2. Materials

Face stimuli were taken from the Nimstim Face Stimulus Set (Tottenham et al., 2012; www.macbrain.org) and comprised the same male and female actors used in the Emo-GNG (see section 4.2.2. for details). The facial expressions used in the Emo-Stroop were angry, happy, and calm (i.e. neutral). Each image was converted to grey-scale, with dimensions of 256 x 329 pixels. Different actors (identities: 7, 14, 20, 38) and emotional facial expressions (fearful) were used for the practice trials. For each face the word 'angry' or 'happy' was superimposed over the bridge of the nose so as not to obscure any features, in capitalized arial font at a size of 30 with 10% transparency. The stimuli were presented centrally on the monitor at a size of 13 cm high by 10 cm wide.

4.3.3. Procedure

The Emo-Stroop task took approximately 15 minutes to complete. This comprised 16 practice trials, followed by three experimental blocks each comprising 48 trials. The blocks were emotion specific (i.e. angry face, happy face, calm face), and contained an equal number of trials in which the word was 'happy' or 'angry'. Trial and block orders were randomized. The task was 2-AFC with participants instructed to respond by pressing the 1 or 2 keys on the keyboard with the index and middle finger of their right hand depending upon whether the word was positive (i.e. 'happy') or negative (i.e. 'angry') (button mappings were counterbalanced across the sample) (see appendix F for full instructions).

Each stimulus was presented for 500 ms, followed by a fixation screen comprising a white cross presented centrally atop a black background. The duration of the fixation screen was jittered, ranging from 4500 ms - 6000 ms ($M \pm SD$ = 5250 ms ± 565 ms). Responses were recorded within a 2500 ms window, which incorporated the 500 ms stimulus presentation and 2000 ms of the post-stimulus fixation screen. Any trials in which the participant failed to respond within this time window were classed as incorrect. Details of each condition are presented in table 4.2 and a schematic of the Emo-Stroop trial structure is depicted in figure 4.4.

Table 4.2.
Block structure and trial numbers for the Emo-Stroop conditions

Face (trial N)	Word (trial N)	Trial type
Happy (48)	Happy (24)	Congruent
	Angry (24)	Incongruent
Angry (48)	Happy (24)	Incongruent
	Angry (24)	Congruent
Calm (48)	Happy (24)	Control
	Angry (24)	Control

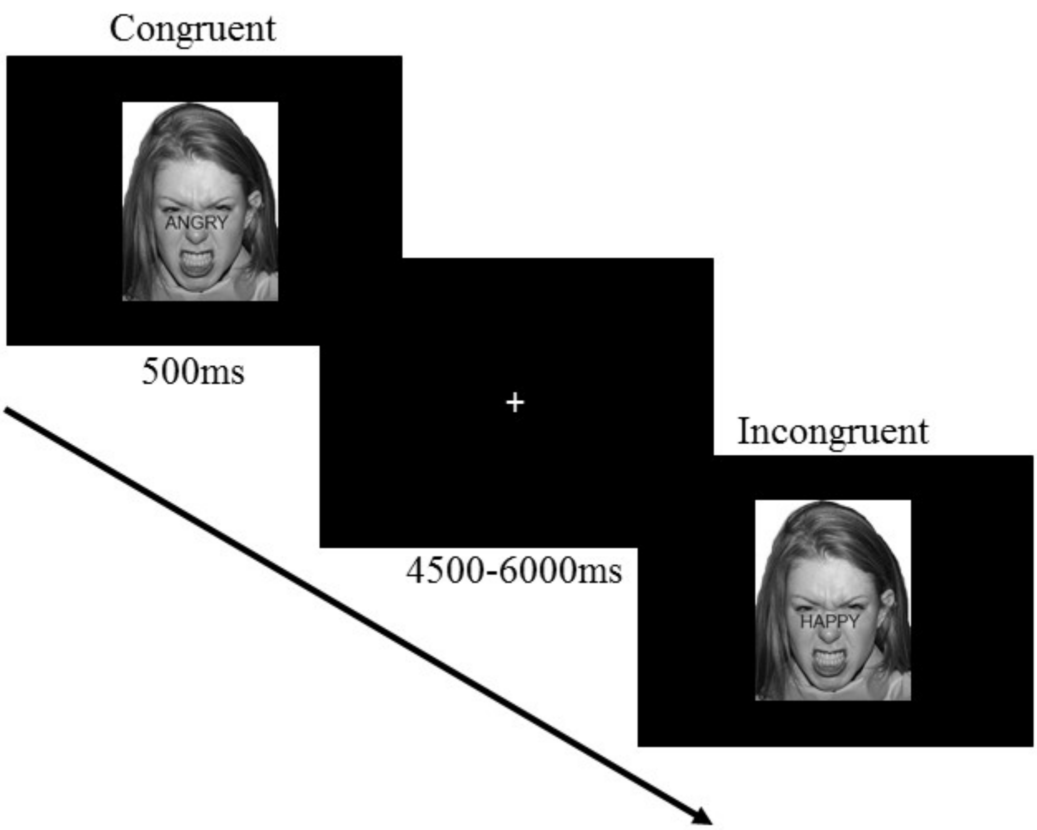

Fig. 4.4. Schematic of trial events in the Emo-Stroop. This figure depicts examples of a congruent and an incongruent trial in the angry face block.

4.3.4. Data reduction and analyses

An unexpected error in the task programme resulted in data for a significant number of trials being lost for two participants; these cases were removed prior to analysis. Two participants who failed to complete the necessary questionnaire data were removed. To ensure data quality, overall mean accuracy was assessed in order to identify any participants who had failed to correctly follow the task instructions. Participants with an overall mean accuracy more than 3*SD below the group mean (< 55.35% accuracy) were removed (5 cases), leaving a final sample of N = 83, which was subject to analysis. Incorrect trials (mean number of trials removed per participant = 12.28, SD = 8.07) or trials in which the RT deviated from the group mean by more than 3*SD were removed (mean number of trials removed per participant = 8.08, SD = 10.65). The mean number of trials per block following all removals was 41.21 (SD = 4.76).

The dependent variable in the Emo-Stroop was RT for correct trials. These data were analysed using a repeated measures ANOVA, with face (angry/happy/calm) and word (angry/happy) as within-subjects factors. Greenhouse Geisser corrected values are reported where the assumption of sphericity was not satisfied. Given the inclusion of a neutral (calm face) control condition, this paradigm enabled the separate assessment of interference (resulting from incongruent task-irrelevant emotional faces) and facilitation (resulting from congruent task-irrelevant emotional faces) effects. These metrics were calculated by subtracting the mean RT for the neutral control condition from the mean RT for the incongruent condition (emotion interference effect) and subtracting the mean congruent RT from the mean neutral control RT (emotion facilitation effect).

Bivariate correlations were used to examine the relationship between trait empathy and the Emo-Stroop task metrics. Normality of each variable was assessed using Kolmogorov-Smirnov tests. Spearman's rho was used in instances where any of the variable distributions deviated significantly from normality. All tests were two-tailed, with a significance threshold of $p < .05$. To ensure that the observed results were not unduly influenced by a small number of outlier cases, the same analyses reported in the results section were conducted following the removal of univariate and bivariate outlier cases (see appendix F).

4.3.5. Results

Mean accuracy was 91.47% (SD = 5.6), which confirms that participants were able to complete the task as instructed. A repeated measures ANOVA examining the effect of face (angry/happy/calm) and word (angry/happy) on the dependent variable RT, demonstrated a significant main effect of word, $F(1, 82) = 19.05$, $p < .001$, partial $\eta^2 = .19$, but no main effect of face, $F(2, 164) = .13$, $p = .88$, partial $\eta^2 = .002$. The expected face by word interaction was at trend-level, $F(2, 164) = 2.31$, $p = .10$, partial $\eta^2 = .03$.

Post-hoc analyses

Post-hoc pairwise comparisons with Bonferroni adjustment revealed that RT was significantly lower for the word happy (*M* ± *SD* = 590.66 ms ± 94.98 ms) compared with the word angry (*M* ± *SD* = 604.16 ms ± 94.38 ms) ($p < .001$). While the word by face interaction did not reach significance, the data were suggestive of some differences in the magnitude of the happy word RT advantage across the different face conditions. This was explored further using post-hoc pairwise comparisons with Bonferroni adjustment.

In the calm face condition, RT for the word happy (*M* ± *SD* = 593.44 ms ± 101.22 ms) was significantly shorter than for the word angry (*M* ± *SD* = 603.64 ms ± 100.28 ms) ($p = .04$). Similarly, in the happy face condition, RT for the word happy (*M* ± *SD* = 586.80 ms ± 102.06 ms) was significantly shorter than for the word angry (*M* ± *SD* = 608.65 ± 101.07 ms) ($p < .001$). However, in the angry face condition, the difference between RT for the word happy (*M* ± *SD* = 591.75 ms ± 98.13 ms) and the word angry (*M* ± *SD* = 600.19 ms ± 98.64 ms) did not reach significance ($p = .11$) (fig. 4.5, left panel).

In sum, while the predicted face by word interaction did not reach significance, there was some evidence of emotional interference effects, which reduced the positive word RT advantage in the angry face condition. To test more directly for interference and facilitation effects, paired samples t-tests were used to compare RT across the congruent, incongruent, and control conditions. No significant differences were observed between the control condition and the congruent ($t(82) = 1.15$, p = .26) or incongruent ($t(82) = .34$, p = .73) conditions. The difference between the congruent and incongruent conditions was approaching significance, $t(82) = 1.816$, p = .07 (fig. 4.5, right panel).

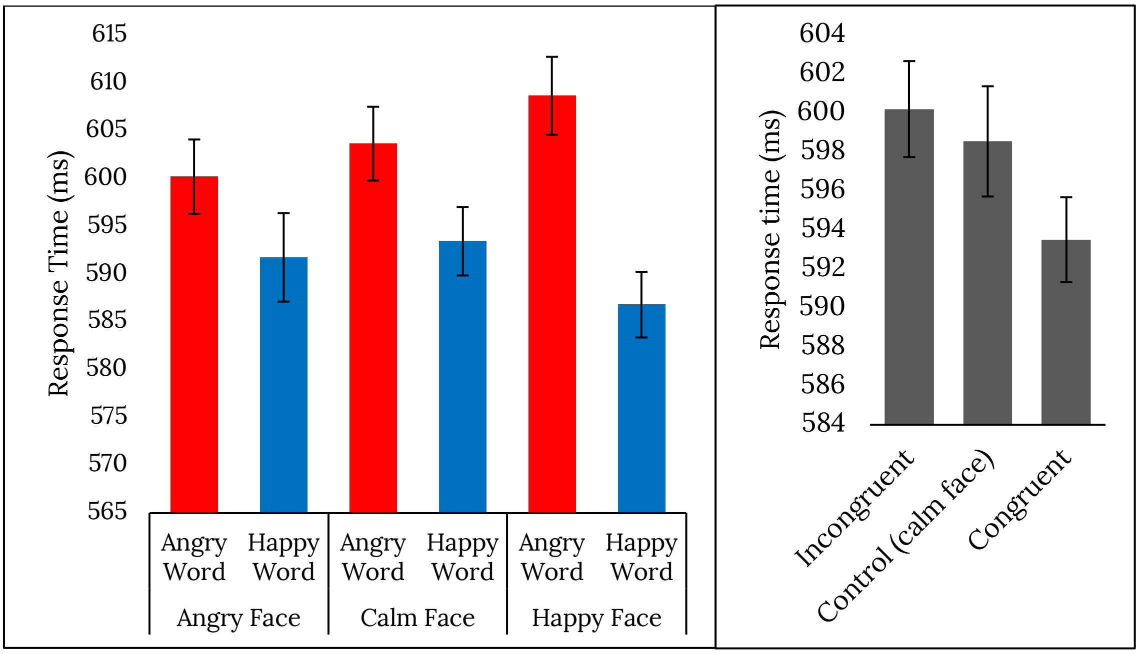

Fig. 4.5. Mean RT across each condition in the Emo-Stroop task (left panel). Mean RT for the incongruent, congruent, and control conditions (right panel). Error bars depict ± 1 within-subjects SEM.

Emo-Stroop task correlations with trait empathy

Trait cognitive empathy was negatively correlated with the Emo-Stroop emotion interference effect, *rho*(81) = -.24, p = .03. In contrast, affective empathy showed no relationship with the emotion interference effect, *rho*(81) = .003, p = .98. These correlations were significantly different, Steiger's Z = -2.15, p = .03 (fig. 4.6).

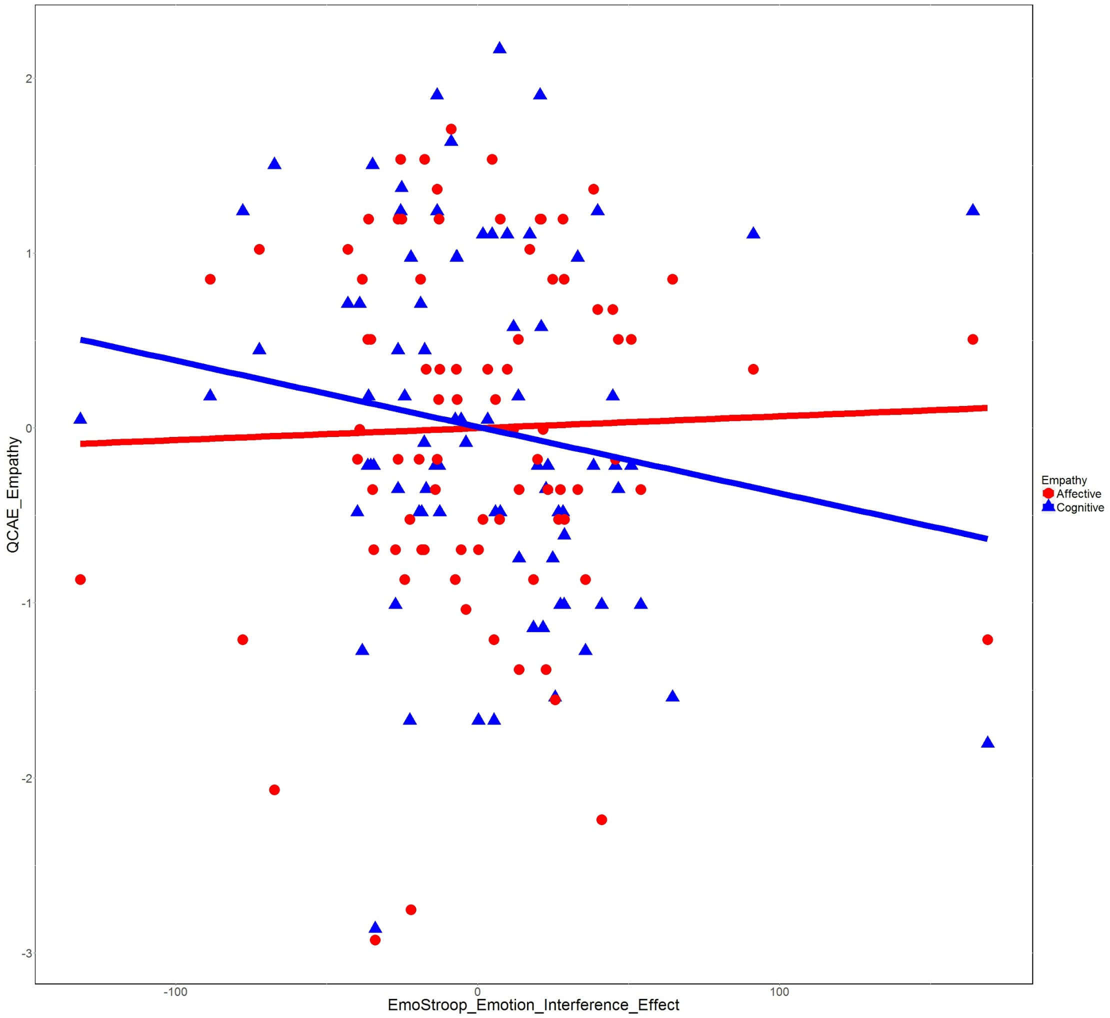

Fig. 4.6. Scatterplot showing the relationship between z-transformed cognitive/affective empathy and the Emo-Stroop emotion interference effect (incongruent RT minus control RT). The emotion interference effect showed a significant negative relationship with cognitive empathy (blue) but was not significantly related to affective empathy (red).

To test whether the reduced emotional interference associated with higher cognitive empathy was driven by a 'gross-level' ignorance of the task-irrelevant emotional faces, which would also reduce the potential for any facilitation effects on congruent trials, the relationship between trait empathy and the emotion facilitation effect was examined.

Cognitive empathy showed a trend-level positive relationship with the emotion facilitation effect, *rho*(81) = .17, p = .13. Affective empathy showed no relationship with the emotion facilitation effect, r(81) = -.03, p = .80. These correlations were not significantly different, Steiger's Z = 1.55, p = .12.

4.4. Discussion

4.4.1. Summary of findings

This study examined the relationship between trait empathy and implicit emotion regulation abilities, as indexed by the magnitude of emotional interference in an Emo-GNG and Emo-Stroop task. The results of both tasks provide some support for the hypothesis that the cognitive and affective dimensions of empathy are differentially related to implicit regulation abilities. Affective empathy was associated with increased emotional interference in the Emo-GNG; however, no relationship was observed for cognitive empathy. In the Emo-Stroop task, cognitive empathy was associated with reduced emotional interference, but no relationship was observed for affective empathy. Taken together, these results provide some support for the hypothesis that cognitive empathy is positively associated with implicit emotion regulation abilities, whereas affective empathy is negatively associated with implicit emotion regulation abilities.

4.4.2. Emo-GNG task

The results of the Emo-GNG task are consistent with prior studies that have reported decreased performance for emotional relative to neutral nogo stimuli (Hare et al., 2005, 2008; Tottenham et al., 2011). Using a measure of D-prime, it was found that participants made significantly more errors (i.e. increased FAR and/or decreased HR) on trials where the nogo stimuli were emotional faces, relative to trials in which the nogo stimuli were calm (i.e. neutral) faces. Furthermore, a significant difference in the magnitude of this emotion interference effect was observed for happy facial expressions relative to expressions of disgust and sadness.

While some prior studies found that differently valenced nogo stimuli disrupt task performance to a similar extent (Tottenham et al., 2011), the findings of the present study are aligned with those reported by Hare et al. (2005), who found evidence of increased emotional interference for positive compared to negative emotional facial expressions in an Emo-GNG task. Consistent with the assertion that positive stimuli are associated with an approach tendency and negative stimuli with an avoid tendency (Hare et al., 2005), the present findings suggest that withholding impulsive responses to happy faces is more difficult than withholding responses to disgusted and sad faces. In sum, the results suggest that the Emo-GNG provides a useful measure of implicit emotion regulation ability, capturing processes associated with the capacity to maintain inhibitory control in the presence of salient emotional distractors, and overcoming the implicit action tendencies evoked by positive and negative emotional stimuli.

Critical to the hypotheses of the study, the magnitude of the Emo-GNG emotion interference effect was positively related to trait affective empathy. This is possibly a reflection of increased spontaneous facial mimicry (SFM) and arousal in response to emotional facial expressions experienced by individuals with higher affective empathy (Rueckert et al., 2011; Sonnby-Borgstrom, 2002), which results in greater difficulty regulating impulsive behaviours in the presence of emotional distractors.

Given evidence for a relationship between cognitive empathy and inhibitory control processes (Carlson et al., 2004; Dennis et al., 2009; Frith and Frith, 2003; Goel et al., 1995; Saxe et al., 2004), it was predicted that higher cognitive empathy would be associated with reduced emotional interference in this task. However, the observed results did not support this hypothesis, as no relationship between trait cognitive empathy and the Emo-GNG emotion interference effect was observed. One possible explanation for the failure to support this hypothesis is that trait measures may assess this dimension of empathy quite broadly, measuring not just perspective-taking, but also other abilities, such as emotion recognition, which may not be so reliant upon cognitive control processes.

4.4.3. Emo-Stroop task

Consistent with previous studies that utilised face-word Emo-Stroop tasks, the present study found evidence for an effect of word valence on response times, with significantly longer RTs observed for the word "angry" relative to the word "happy" (e.g. Stenberg et al., 1998). While significant interference or facilitation effects were not observed in the present study, there was some trend-level evidence of these effects, with a slight RT increase for incongruent trials and a slight RT decrease for congruent trials relative to a neutral control condition.

The failure of these effects to reach significance could be due to the relatively automatic level at which words are processed, which may have attenuated the magnitude of any potential interference/facilitation effects induced by the task-irrelevant faces (Lei et al., 2017). While some prior studies have found evidence to suggest that task-irrelevant faces can influence the processing of the target words (Sternberg et al., 1998), other studies suggest that words are subject to prioritised processing over faces (Ovaysikia et al., 2011), which could explain why the emotional faces did not have a significant impact on RT for classifying the target words.

In relation to the main hypotheses of the study, the results of the Emo-Stroop provide further support for the hypothesis that cognitive and affective empathy share different relationships with implicit emotion regulation. Trait cognitive empathy was negatively correlated with the

Emo-Stroop emotion interference effect, which suggests that individuals with higher levels of cognitive empathy were more efficient in regulating the potential interference caused by the task-irrelevant emotional faces. Furthermore, trait cognitive empathy showed a small positive trend-level relationship with the emotion facilitation effect. This suggests that the observed reduction in emotional interference was not achieved by a more “gross-level” ignorance toward the task-irrelevant faces, which would also have inhibited their potential to facilitate target word processing on congruent trials. The negative relationship between cognitive empathy and emotional interference in the Emo-Stroop is in contrast to the findings of the Emo-GNG, where no relationship with cognitive empathy was observed.

Contrary to expectation, affective empathy showed no relationship with the emotion interference effect in the Emo-Stroop task. It was expected that the heightened reactivity to others’ emotions in individuals with greater affective empathy (Rueckert et al., 2011; Sonnby-Borgstrom, 2002) would have resulted in increased interference (on incongruent trials) and facilitation (on congruent trials) effects. However, neither of these relationships were observed in the present study. This is in contrast to the results of the Emo-GNG task, where a positive correlation between affective empathy and the emotion interference effect was observed.

The divergent relationships that cognitive and affective empathy show with the Emo-GNG and Emo-Stroop could suggest that these tasks are assessing slightly different processes related to implicit emotion regulation. Indeed, it has been asserted that GNG tasks assess response inhibition whereas the Stroop assesses conflict resolution, which reflect closely related but dissociable aspects of cognitive control (Nee et al., 2007; Swick et al., 2011). In the present study, the metrics of emotional interference from each of these tasks were not significantly related to one another (see appendix F), which is in alignment with prior work demonstrating low convergence and different developmental trajectories for Stroop and GNG/stop-signal tasks (Huizinga et al., 2006; Morooka et al., 2012).

Additionally, a speculative explanation for the divergent findings observed in the present study relates to differences in the task-relevance of the emotional face stimuli in these tasks. Given that the faces in the Emo-Stroop were always task-irrelevant, it could be that participants were able to focus their attention more fixedly on the target words. Such an approach would likely have attenuated the potential influence of the emotional faces, which could explain why participants' levels of trait affective empathy did not modulate these task effects. As participants were required to actively attend to the faces in order to perform successfully on the Emo-GNG task, such an approach would not have been possible. This could explain why higher affective empathy was associated with increased emotional interference in this task but not in the Emo-Stroop.

4.4.4. Summary, conclusions, and limitations

This study builds upon the findings of previous chapters by examining the relationship between cognitive/affective empathy and tasks that provide objective performance-based measures of implicit emotion regulation abilities. While some contrasting results were observed across the two tasks, taken together they provide evidence to suggest that higher trait cognitive empathy is associated with improved implicit emotion regulation, whereas higher affective empathy is associated with a diminished ability to regulate early emotional influences on cognitive control processes.

It is important to highlight some potential limitations of the present study. Firstly, some of the components assessed by these task measures are arguably associated more with emotional reactivity rather than emotion regulation per se. Thus, one limitation of these tasks is that it is difficult to determine the extent to which differences in the magnitude of emotional interference were driven by variability in reactivity or regulation, which is a pervasive issue in the field of emotion regulation. Given that regulatory processes can act implicitly and exert an influence at the earliest stages of an affective response (Gross, 2015; Gyurak et al., 2011), it is often difficult to highlight the precise point at which reactivity ends and regulation begins (see Gross and Feldman-Barret, 2011 for review).

In acknowledgment of the limitations of the current study, the following two chapters utilise task measures of emotion regulation that enable greater clarity regarding the delineation between emotional reactivity and emotion regulation. Building upon the findings of chapters 2 and 3, which found some evidence of a relationship between cognitive empathy and reappraisal use, the next chapter tests the relationship between trait empathy and two tasks that assess the ability to downregulate negative emotions using reappraisal.

Chapter 5

Trait empathy and task measures of reappraisal

5.1. Introduction

In chapter 2 it was observed that the cognitive and affective dimensions of trait empathy share different relationships with the habitual use of reappraisal. Reappraisal use was positively associated with cognitive empathy but showed no relationship with affective empathy. The trait measure used in that study assessed only respondents' propensity to use reappraisal, meaning it is not possible on the basis of those results to determine whether higher cognitive empathy is associated with improved reappraisal ability per se. To my knowledge, no studies to date have examined the relationship between empathy and task measures of reappraisal. Across two studies this chapter examines the relationship between trait empathy and tasks that assess participants' ability to downregulate negative emotions based on implicit (study 1) and explicit (study 2) reappraisal.

5.1.1. Task measures of reappraisal

Reappraisal refers to a change in the meaning adhered to an emotion-eliciting stimulus or event in order to lessen (or increase) its emotional impact (Gross, 1998, 2002, 2015). The majority of task-based measures of reappraisal assess what is often referred to as explicit (or instructed) reappraisal. In such tasks, participants are specifically instructed to use reappraisal to modify their emotional experience (e.g. Ochsner et al., 2004a). This approach and its variants have demonstrated a reliable influence of reappraisal on self-reported emotional experience, psychophysiological responses, and neural activation in regions associated with emotional processing and self-regulation (Jackson et al., 2000; Kalisch, 2009; Ochsner and Gross, 2008; Ray et al., 2010).

While such tasks may capture abilities relevant to real-world situations in which the individual exerts a conscious effort to implement reappraisal, day-to-day emotion regulation also involves more implicit and unintentional processes (Gyurak et al., 2011; Mauss et al., 2007). For example, extrinsic contextual information can influence one's appraisals and emotional responses to a stimulus in a relatively implicit manner, without any conscious goal or intention to engage in reappraisal (Berkman and Lieberman, 2009; Mocaiber et al., 2011; Wang et al., 2017).

Some studies have adopted paradigms that assess these more implicitly evoked forms of reappraisal. Such tasks typically involve pairing emotional stimuli with brief descriptions (or frames) that provide a context for interpreting what is happening (e.g. Foti and Hajcak, 2008; Wang et al., 2017). In a seminal early study examining the effects of contextual framing on emotional responses, Lazarus and Alfert (1964) demonstrated how self-report and physiological indices of stress can be modulated by concurrent auditory descriptions that influence the observer's interpretation of stress-inducing videos. More recent studies provide further evidence of the modulatory effect of contextual framing on emotional responding (Dennis and Hajcak, 2009; Foti and Hajcak, 2008; Kim et al., 2004; MacNamara et al., 2009; Mocaiber et al., 2010, 2011; Wang et al., 2017; Wu et al., 2012). In contrast to explicit reappraisal paradigms, participants are not given any overt instruction to regulate their emotions in framing tasks and are required to simply attend to the stimuli in each condition. Thus, framing tasks are distinct from explicit reappraisal tasks in that their influence on emotional experience is driven largely by extrinsic (i.e. arising outside the individual) rather than intrinsic (i.e. arising from within the individual) factors, and they are thought to capture reappraisal of a more implicit and unintentional nature (Foti and Hajcak, 2008; Mocaiber et al., 2011; Wang et al., 2017).

5.1.2. The current studies

In this chapter, I report two studies that examined the relationship between trait empathy and the magnitude of negative emotion downregulation in an implicit (study 1) and explicit (study 2) reappraisal task. I use the term "explicit" to refer to instances in which reappraisal was driven by a deliberate attempt to alter one's emotional experience. I use the term "implicit" to refer to less deliberate forms of reappraisal, where one's emotional response was influenced by extrinsic factors without the necessity for any conscious intent to engage in reappraisal (Berkman and Lieberman, 2009).

Based on the results of previous chapters and the extant theoretical and empirical work discussed in the introductory chapter, it was predicted that cognitive, but not affective, empathy would be positively related to the magnitude of emotion downregulation in an implicit and explicit reappraisal task. A summary of the study hypotheses is presented below.

1) *Cognitive empathy will show a positive relationship with metrics of regulation magnitude in an implicit and explicit reappraisal task.*

2) *Affective empathy will show no relationship with metrics of regulation magnitude in an implicit and explicit reappraisal task.*

5.2. Study 1: Trait empathy and implicit reappraisal

This first study examines how variability in trait empathy relates to the implicit reappraisal of negative images driven by preceding sentence frames that provide a context for interpreting what is happening in the depicted situation. Implicit reappraisal was operationalised as the difference in ratings of self-reported emotional experience (valence) between negative images paired with descriptive framing sentences (which simply described the image content, thereby providing a baseline measure of participants' emotional response) and negative images paired with neutralising framing sentences (which aimed to reduce the unpleasantness of participants' appraisals of the images). It was predicted that the implicit reappraisal task metric would be positively related to trait cognitive empathy but show no relationship with affective empathy.

5.2.1. Participants

Given that implicit reappraisal is less reliant than explicit reappraisal upon cognitive control processes also associated with cognitive empathy, it was expected that the relationship between trait empathy and reappraisal ability would be of a similar magnitude to the effects reported for trait reappraisal use in chapter 2. An a priori sample size estimation using G*Power 3.1. (Faul et al., 2007) suggested that a minimum sample of 82 was required to detect effects of a small to moderate magnitude with power of .80, at an alpha level of p = .05. Ninety-two participants (73 females) were recruited from the undergraduate population at the UOR to take part in a one-hour study on "mood and cognitive performance". All participants had normal or corrected to normal vision, and the mean age was 20.24 years (*SD* = 2.21; range = 18-35). Participants were recruited via the university online participant pool and were awarded course credit for participation.

5.2.2. Materials

Empathy. Trait empathy was measured using the QCAE (Reniers et al., 2011). Within this sample, both sub-scales of the QCAE demonstrated high internal consistency ($\alpha_{\text{Cognitive Empathy}}$ = .87; $\alpha_{\text{Affective Empathy}}$ = .84).

Affective images. Forty images (20 negative. 20 neutral) were selected from the International Affective Picture System (IAPS) database (Lang et al., 2005). All images were of a social nature, which was defined broadly as including a sentient target (or targets), for which one could infer an emotional/cognitive state and/or experience an emotional reaction in response to observing the target's situation. A range of IAPS image types were used, including: Mutilation/injury, assault/attack, soldier, firefighter, car accident, scared/sick child, drugs, burn victim (negative); neu- man/woman/child, office, bakers, factory worker, harvest (neutral).

Based on the normative ratings provided in the IAPS manual (Lang et al., 2005), independent samples t-tests demonstrated that the negative images had a significantly lower mean valence ($M_{valence}$ = 2.35, SD = 0.41) and significantly higher mean arousal ($M_{arousal}$ = 5.67, SD = 0.91), compared to the neutral images ($M_{valence}$ = 5.25, $SD_{valence}$ = 0.56; $M_{arousal}$ = 3.56, $SD_{arousal}$ = 0.49), (valence, $t(38) = 18.58$, $p < .001$; arousal, $t(38) = 9.14$, $p < .001$).

Reappraisal framing sentences. Forty framing sentences were used (20 neutralising, 20 descriptive), which were taken from prior studies on reappraisal framing where possible. Seven sentences were taken from Foti and Hajcak (2008), two of which were edited slightly to make the context less ambiguous. Thirty-two sentences were taken from an unpublished study conducted by collaborators and one new sentence was created to fit the current image set (see appendix G for all negative and neutral IAPS image numbers with accompanying framing sentences). An independent samples t-test confirmed that the different sentence types did not differ in terms of word count ($M_{descriptive}$ = 8.6, $SD_{descriptive}$ = 1.79; $M_{neutralising}$ = 8.7, $SD_{neutralising}$ = 1.84), $t(38)$ = .26, p = .80.

All participants saw the same 40 images in block 1 (freeview condition). Half of the neutral images from block 1 were shown again in block 2 with an accompanying descriptive framing sentence. The ten neutral images presented in block 2 were counterbalanced across the sample. Based on the normative IAPS ratings (Lang et al., 2005), an independent samples t-test demonstrated that the different neutral image sets shown in block 2 did not differ significantly in valence, $t(18)$ = .94, p = .36, or arousal, $t(18)$ = .67, p = .51. For block 2, two sets of 10 images were created from the 20 negative images shown in block 1. These negative image sets were matched based on the image category (e.g. injury, drugs etc.), complexity, and the age, race, and number of depicted individuals. Based on the normative ratings (Lang et al., 2005), independent samples t-tests showed that these two negative image sets did not differ significantly in terms of valence (M_{set1} = 2.33, SD_{set1} = 0.45; M_{set2} = 2.37, SD_{set2} = 0.39) or arousal (M_{set1} = 5.65, SD_{set1} = 0.62; M_{set2} = 5.70, SD_{set2} = 1.16); valence, $t(18)$ = .20, p = .85; arousal, $t(18)$ = .12, p = .91. In block 2, half of the negative images were paired with descriptive sentences and half with neutralising sentences; image-sentence pairings were counterbalanced across the sample.

5.2.3. Procedure

Participants read the information sheet and provided written consent to participate. All testing was completed in isolation, in a distraction-free environment. Participants were sat at an approximate viewing distance of 60cm from the monitor, which had a refresh rate of 60Hz and ran the task at a resolution of 600 x 800. The implicit reappraisal framing task was completed as part of a larger battery, which took approximately one hour in total. The task consisted of two blocks comprising 70 trials in total (Block 1: 20 negative, 20 neutral images; Block 2: 20 negative, 10 neutral images), and lasted on average approximately 20 minutes. While of primary interest were the negative image ratings across the different framing conditions, neutral images were included as a manipulation check and as a means of slowing habituation to negative images.

Participants were informed that they would view a series of images and were asked to report after each "how unpleasant/pleasant they felt in response to the image" (see appendix G for full instructions). Ratings were made using the keyboard and a 1-9 bipolar scale was used, where: 1 = extremely unpleasant, 5 = neutral, 9 = extremely pleasant. While no positive images were used in the task, a bipolar valence scale covering the range from unpleasant to pleasant was used to maintain consistency with ratings scales used in previous studies (Foti and Hajcak, 2008; MacNamara et al., 2009) and to account for the possibility that the neutralising reappraisal frames could result in the images being appraised as more positive/pleasant than neutral. Participants were asked to provide honest ratings based on their "initial reaction" upon viewing each image. The images in each block were presented in a randomised order. Block 1 trials followed the same sequence as those in block 2 (depicted in fig. 5.1), except there was no framing sentence event between the initial fixation and image presentation.

Prior to commencement of block 2, participants were allowed to take a short break. They were then presented with an instruction screen informing them that in the next block each image would be preceded by a "sentence that provides some context for what is happening in the image". At no point prior to or during the testing session was there any reference to emotion regulation. Block 2 consisted of the same 20 negative images from block 1, with half preceded by a descriptive framing sentence and the other half preceded by a neutralising framing sentence. The 10 neutral images presented in block 2 were all preceded by a descriptive framing sentence. The term reappraisal implies a process of altering one's interpretation of a situation after an initial appraisal has been formed. While the framing sentences preceded the images in block 2, participants had already viewed and formed an appraisal of the images during the freeview condition (block 1). As any change in the intensity of negative experience elicited by the images would rely upon participants altering their original appraisals, this task is best defined as a measure of implicit reappraisal, rather than what is sometimes referred to as 'pre-appraisal' (Matarazzo et al., 2014).

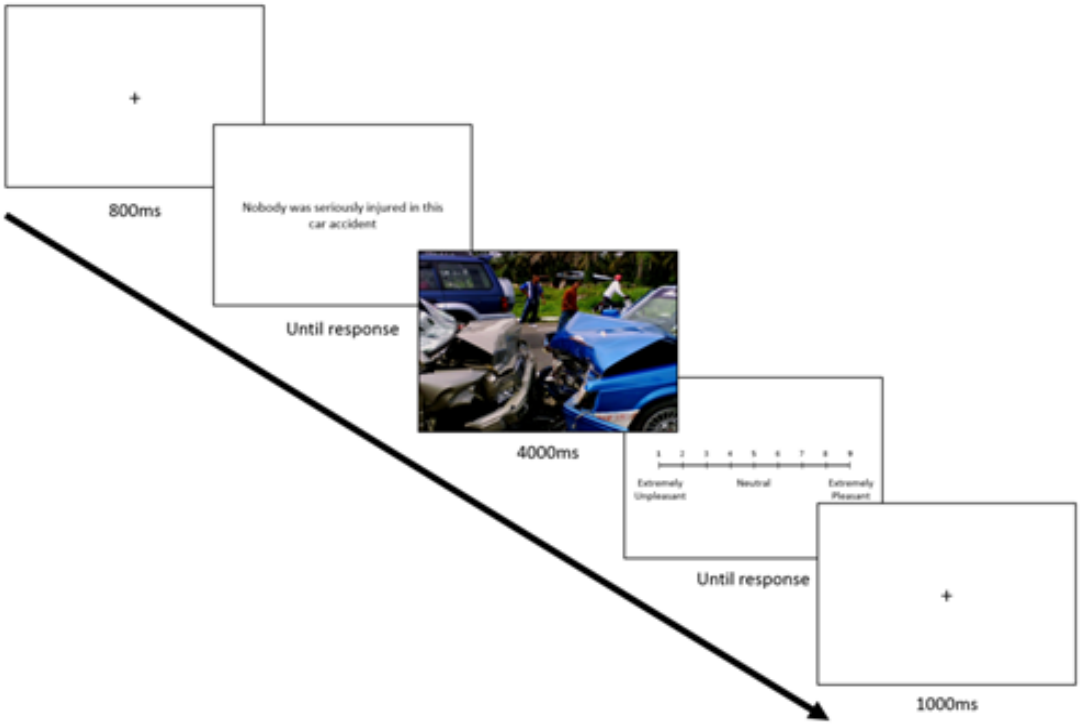

Fig. 5.1. Schematic of trial events during block 2 of the implicit reappraisal task. Each trial consisted of the following events: 1) white screen with black central fixation cross; 2) neutralising or descriptive framing sentence; 3) IAPS image (neg or neu); 4) white screen with centrally presented rating scale (1-9); 5) white screen with black central fixation cross (1000ms). The image shown above was selected from the OASIS images set (Kurdi et al., 2017) as a representative example and was not one of those used in the task.

5.2.4. Data reduction & analyses

Two participants were removed prior to analysis for failing to correctly follow task instructions, leaving a final sample of N = 90. The key metric of implicit reappraisal was the extent to which participants reported a decreased negative emotional response to negative images paired with neutralising framing sentences (NegNEU condition) relative to negative images paired with descriptive framing sentences (NegDES condition). This metric was termed ‘implicit reappraisal’ and was calculated by subtracting the mean NegDES rating from the mean NegNEU rating. As such, higher implicit reappraisal scores reflect a greater reduction in unpleasant experience as a result of the neutralising framing sentences. This metric provides a measure of the extent to which the extrinsic framing sentence type influenced participants' emotional reaction to the negative images, while controlling for the intrinsic valence of the stimulus.

Separate paired samples t-tests were used to examine the effects of image (negative, neutral) and sentence frame (neutralising, descriptive) on self-reported valence ratings. Individual differences were examined using bivariate correlations testing the relationship between the implicit reappraisal metric and trait cognitive/affective empathy. Normality of each variable was assessed using Kolmogorov-Smirnov tests. Spearman's Rho is reported for correlations where any of the variable distributions deviated significantly from normality. All correlations are reported as two-tailed with a significance threshold of $p < .05$. To ensure that the observed results were not unduly influenced by a small number of outlier cases, the same analyses reported in the results section were conducted following the removal of univariate and bivariate outlier cases (see appendix G).

5.2.5. Results

5.2.5.1. *Implicit reappraisal task*

Block 1 valence ratings for negative images ($M = 2.49$, $SD = .77$) were significantly lower (i.e. more negative) than for neutral images ($M = 5.58$, $SD = .60$), $t(89) = -27.94$, $p < .001$. Valence ratings in the NegNEU condition ($M = 4.38$, $SD = .97$) were significantly less negative than in the control NegDES condition (M = 2.92, SD = .77), $t(89)$ = 15.17, p < .001 (fig. 5.2), which suggests that the context-framing had the expected effect on self-reported emotional experience.

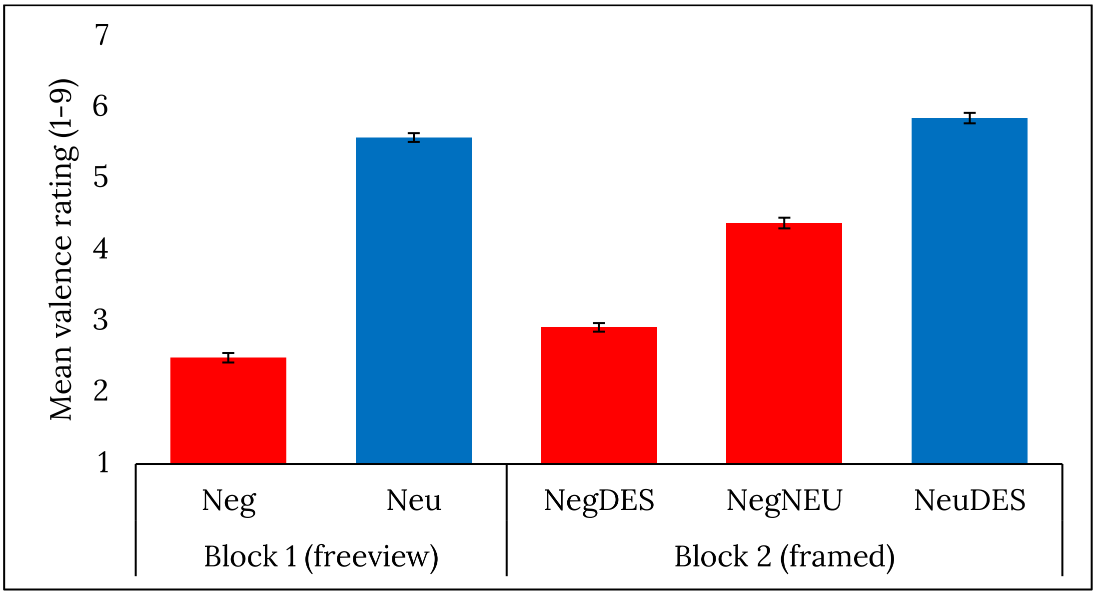

Fig. 5.2. Mean valence ratings for each condition in the implicit reappraisal task (1 = extremely unpleasant, 5 = neutral, 9 = extremely pleasant). In block 1, negative images (Neg) were associated with more negative emotional experience relative to neutral images (Neu). In block 2, negative images paired with a neutralising framing sentence (NegNEU) showed reduced negative (more neutral) experience relative to the baseline condition in which negative images were paired with descriptive framing sentences (NegDes). Error bars depict ±1 within-subjects SEM.

Relationship between trait empathy and implicit reappraisal

Trait cognitive empathy showed no relationship with the implicit reappraisal metric, $r(88)$ = -.06, p = .60. However, a significant positive correlation was observed between affective empathy and the implicit reappraisal metric, $rho(88)$ = .33, p = .002. This suggests that higher affective empathy was associated with reduced negative/more neutral ratings of negative images after providing a neutralising framing context.

These two correlations were significantly different, Steiger's Z = -3.22, p = .001 (fig. 5.3).

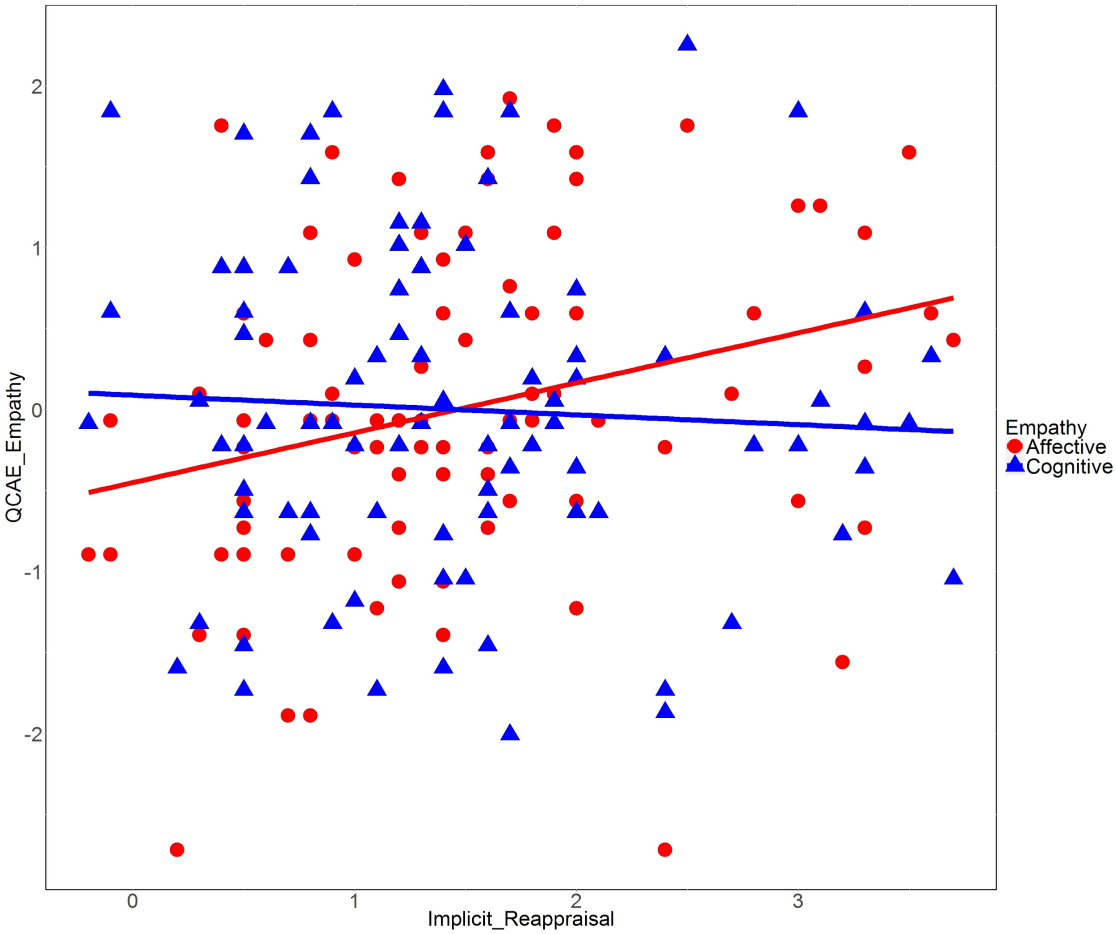

Fig. 5.3. Scatterplot showing the relationship between the implicit reappraisal task metric (NegDES - NegNEU condition valence ratings) and Z-transformed trait cognitive/affective empathy (QCAE). Affective empathy (red) was positively correlated with implicit reappraisal (i.e. enhanced reduction in self-reported negative experience for negative images paired with a neutralising framing sentence, relative to negative images paired with a descriptive framing sentence). Trait cognitive empathy (blue) showed no relationship with implicit reappraisal.

5.2.6. Study 1 discussion

The finding of a significant reduction in self-reported unpleasant experience for negative stimuli paired with neutralising framing sentences is consistent with prior work demonstrating an influence of context framing on emotional experience (Dennis and Hajcak, 2009; Foti and Hajcak, 2008; Kim et al., 2004; MacNamara et al., 2009; Mocaiber et al., 2011; Wang et al., 2017; Wu et al., 2012). Contrary to the study hypotheses, it was observed that affective, but not cognitive, empathy was positively related to implicit reappraisal (defined as the extent to which participants experienced a reduction in negative emotional experience for negative images preceded by neutralising frames, relative to descriptive frames).

The framing task used in this study provides a measure of more implicit reappraisal; specifically, the downregulation of negative affect resulting from extrinsic contextual information, in the absence of a specific instruction or conscious intention to alter one's emotional state. Such implicit reappraisal processes are likely to be less cognitively demanding than reappraisal use in many real-life situations as there is no need for explicit goal switching and/or self-generation of reappraisal narratives (Wang et al., 2017). Thus, it might be that high cognitive empathy supports only the more cognitively demanding forms of reappraisal and confers little advantage in terms of more implicit reappraisal processes.

The positive relationship between affective empathy and the implicit reappraisal task metric could be a reflection of the heightened emotional awareness associated with greater affective empathy (see chapter 2), which may support the updating of emotion-relevant appraisals (Gross, 2015). These results are discussed in further detail in the general discussion section of this chapter.

5.3. Study 2: Trait empathy and explicit reappraisal

Contrary to expectations, the results of study 1 demonstrated that affective, but not cognitive, empathy was positively associated with the magnitude of implicit reappraisal in a framing task. One potential reason for the failure to find a significant relationship between cognitive empathy and the framing task metric is that this paradigm assesses reappraisal of a more implicit nature (Foti and Hajcak, 2008). The use of reappraisal in daily life may often place greater reliance on cognitive control processes, which mediate more demanding processes such as the generation of potential reappraisals that may serve to alter one's emotional response to a given situation/stimulus (Etkin et al., 2015; McCrae et al., 2010; Urry et al., 2009). Therefore, it could be that greater cognitive empathy supports only these more demanding forms of reappraisal and provides little advantage with regard to more implicit reappraisal processes.

Building upon the findings of study 1, this next study examined the relationship between trait cognitive/affective empathy and a task-based measure of explicit reappraisal ability. In order to provide a more objective and holistic measure of emotional experience, this study combined self-report measures of valence and arousal with a novel methodology that utilises video-based automated facial coding of affective states. It was predicted that cognitive but not affective empathy would be positively associated with the magnitude of negative emotion downregulation in an explicit (i.e. instructed) reappraisal task.

5.3.1. Automated facial coding

It has long been suggested that facial expressions of emotion are “hard-wired” and play an important role in human social communication (Darwin, 1872). In alignment with Cacioppo et al.’s (1986) assertion that facial expressions of emotion are typically associated with congruent emotional experiences, there is theoretical and empirical work suggestive of a close relationship between facial expressions and the valence of an individual's emotional state (Buck, 1994; Mauss et al., 2005; Russell, 1994). Consequently, comparing facial expressions indicative of the valence/intensity of affective states across regulation conditions can provide a more objective and implicit measure of participants’ reappraisal ability.

While manual coding of facial expressions has for many years been the predominant method of classifying affective facial expressions (see Cohn et al., 2007; Ekman and Friesen, 1978, for reviews), such procedures are often laborious and require extensive training (Ekman and Friesen, 1978; Ekman et al., 2002). Recent advances have enabled the development of software that can reliably categorise emotion states based on images or videos of the face (Valstar et al., 2012). One such piece of software, Facereader (Noldus), has been available for research use since 2005 (den Uyl and van Kuilenberg, 2005; van Kuilenberg et al., 2005) and has proven useful in a range of contexts, from social/affective psychology (Chentsova-Dutton and Tsai, 2010) to consumer science (Chan et al., 2014). Facereader was trained to classify the basic universal emotions described by Ekman (1992) using validated image sets of facial expressions (Olszanowski et al., 2015; van der Schalk et al., 2011). In addition to achieving an average recognition score approaching 90% across the six basic emotions, Facereader has been found to correctly classify neutral facial expressions with an accuracy of 94% (den Uyl and van Kuilenberg, 2005; Lewinski et al., 2014; Lewinski, 2015).

This study utilised self-report and automated facial coding (AFC) measures of emotional experience to examine the relationship between trait cognitive/affective empathy and the ability to downregulate negative emotions using reappraisal. AFC metrics of emotional expression were used to assess emotion regulation by examining differences in facial expressions indicative of the intensity of emotional experience across conditions in which participants were instructed to respond naturally or use reappraisal to downregulate any negative experience evoked by the affective stimuli. It was predicted that the explicit reappraisal task metric would be positively associated with cognitive empathy but show a negative relationship with affective empathy.

5.3.2. Participants

As this task assesses reappraisal ability under more demanding conditions (i.e. where participants must self-generate reappraisal narratives), it was expected that this metric would be more strongly associated with cognitive empathy than the implicit task, as it is more heavily reliant upon cognitive control processes also associated with cognitive empathy. An a priori sample size estimation using G*Power 3.1 (Faul et al., 2007) suggested that to detect correlations of a moderate to large effect size at an alpha level of p = .05 and power of .80, a sample of 44 participants was required.

Forty-four participants (35 female) were recruited from the UOR student population via the online participant pool. The mean age (±*SD*) of the sample was 19.64 (±1.56). Two participants, for whom the necessary questionnaire data was incomplete were removed prior to analysis. A further three participants were removed following data quality checks (see *data reduction & analyses* section for details), leaving a final sample of N = 39, which was subject to analysis.

5.3.3. Materials

Empathy. Trait empathy was assessed using the QCAE. Cronbach's alpha was high for the cognitive empathy subscale, $\alpha_{\text{Cognitive}} = .89$, but somewhat lower for the affective empathy subscale ($\alpha_{\text{Affective}} = .67$). While the typical threshold for acceptability is Cronbach's alpha >= .70, it has been asserted that for scales with fewer than 20 items, a Cronbach's alpha greater than .50 should be considered satisfactory (Dall'Oglio et al., 2010).

Affective images. Thirty-six images (24 negative, 12 neutral) were selected from the IAPS database (Lang et al., 2005) (see appendix G for IAPS image numbers). As in study 1, all images were of a social nature and included a range of IAPS image types. Two sets of negative images were created, one of which was used for the "rethink" (i.e. reappraisal) condition and the other for the "watch" (i.e. control) condition; these image set-condition pairings were counterbalanced across the sample.

Based on the normative IAPS ratings (Lang et al., 2005), independent samples t-test demonstrated that the two negative image sets did not differ in terms of valence ($M_{set1} = 2.24$, $SD_{set1} = 0.31$; $M_{set2} = 2.31$, $SD_{set2} = 0.44$; $t(22) = .42$, $p = .68$) or arousal ($M_{set1} = 5.62$, $SD_{set1} = 0.82$; $M_{set2} = 5.74$, $SD_{set2} = 0.56$; $t(22) = .40$, $p = .70$). Normative valence ratings for negative images (M = 2.27, SD = 0.38) were significantly lower than for neutral images (M = 5.36, SD = 0.57), $t(34) = 19.46$, $p < .001$, and normative arousal ratings were significantly higher for negative (M = 5.69, SD = 0.69) compared with neutral images (M = 3.63, SD = 0.46), $t(34) = 9.31$, $p < .001$.

Video recording. Videos of participants' faces were recorded throughout the task using a Microsoft Lifecam positioned in front of participants below the monitor on which the task was completed. Videos were recorded at a frame rate of 30 fps and a resolution of 640 x 480. A professional photography spotlight positioned above the monitor was used to reduce any shadows on participants' faces and improve the quality of the video recordings for the Facereader analysis. For ethical reasons participants had to be informed about the video recording prior to the experiment; to reduce the potential that participants were overly conscious of their facial expressions during the task, they were informed that the webcam was being used to track their eye-gaze patterns.

5.3.4. Procedure

Participants provided written informed consent to participate. Questionnaires were completed online and the explicit reappraisal task as part of a lab-based session. The task lasted approximately 20 minutes on average, and all testing was completed in isolation in a distraction-free environment. Participants were sat at an approximate viewing distance of 60 cm from the monitor, which displayed the task at a resolution of 600 x 800, with a refresh rate of 60 Hz.

Prior to commencement of the task, participants read the instructions and were given the chance to ask any questions to ensure they understood what the task entailed. They were instructed that they would be shown various images and would then be asked to rate how each image made them feel. They were informed that prior to each image an instruction word would be presented, which would either be “WATCH” or “RETHINK”. Participants were instructed that in the watch condition, they should let any thoughts/feelings evoked by the image unfold naturally. For rethink trials, participants were instructed to try to think about what is happening in the image in a way that reduces any negative experience. They were advised that they should attend to all images and not try to regulate their emotions by simply thinking about something else. They were also informed that the images depicted real situations and that they should not simply try to tell themselves that the images are merely staged. This was done in order to increase the ecological validity of the task, as the use of such reappraisals would be unlikely in real life situations (see appendix G for full instructions).

Participants then completed a training block comprising two watch trials and two rethink trials. To ensure participants understood the task instructions and were able to successfully self-generate potential reappraisals, following each practice rethink trial the experimenter asked participants if they managed to think about the image in a way that made them feel less negative, and what this reappraisal entailed. All participants were able to demonstrate that they understood the task and could come up with appropriate reappraisals.

The main task included 36 trials; twenty-four negative image trials (12 watch, 12 rethink), and twelve neutral image trials (6 watch, 6 rethink), which were presented in a randomised order. Trials comprised the following sequence of events: 1) ITI Fixation (5000ms); 2) Instruction (4000ms) stating whether the trial is "WATCH" or "RETHINK"; 3) Pre-stimulus fixation (2000ms), during which the baseline measure of AFC valence was taken; 4) stimulus (8000ms), either a negative or neutral IAPS image; 5) valence rating screen (1-9; until response); 6) arousal rating screen (1-9; until response). A schematic of trial events is shown in figure 5.4.

Participants responded to each image by rating how unpleasant/pleasant it made them feel (valence rating), and how arousing they found the image. Both ratings were provided using a 9-point scale, where in the case of valence: 1 = extremely unpleasant, 5 = neither pleasant nor unpleasant, 9 = extremely pleasant, and in the case of arousal: 1 = extremely relaxing, 5 = neither relaxing nor arousing, 9 = extremely arousing. While arousal is typically rated on a unipolar scale ranging from low to high, a bipolar arousal scale was used in this instance to minimise the potential for mistakes in responding due to confusion caused by rating two 1-9 scales in quick succession, one of which is bipolar and the other unipolar.

While the main task analysis focused upon negative images only, as in study 1, neutral images were included as a manipulation check, and to slow the rate of habituation to negative images.

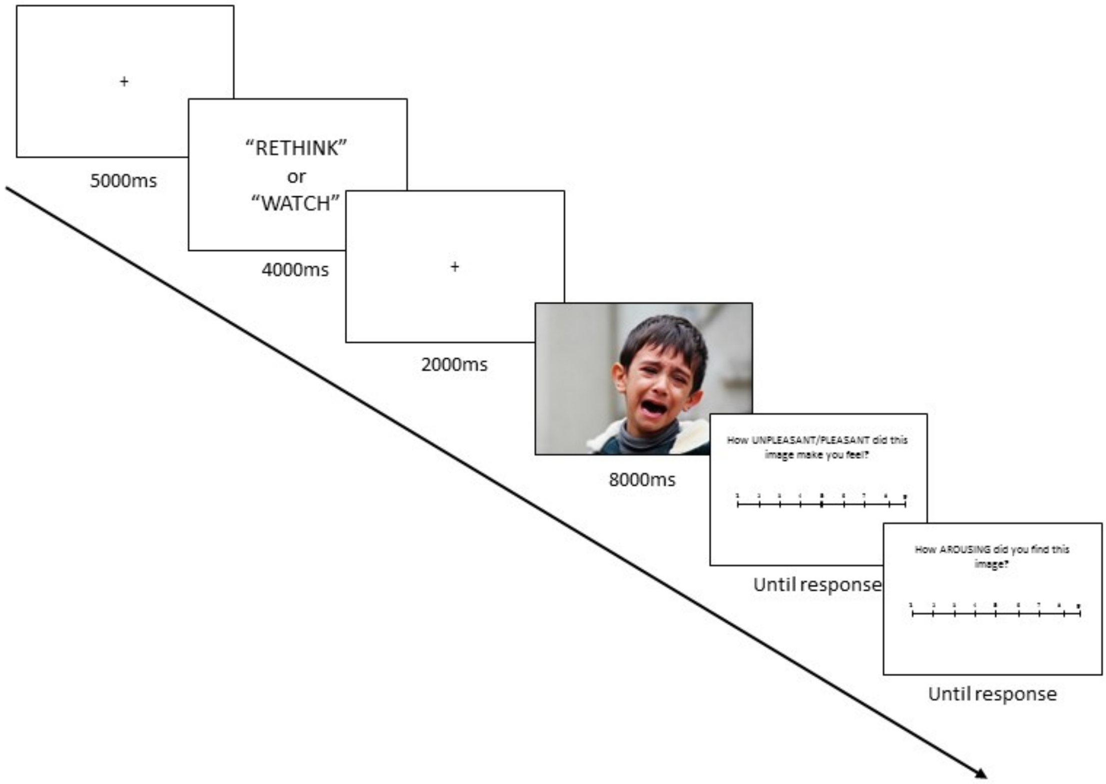

Fig. 5.4. Schematic of trial events in the explicit reappraisal task. Each trial consisted of the following events: 1) white screen with black central fixation cross (5000ms); 2) instruction: either "watch" or "rethink" (4000ms); 3) Pre image fixation baseline (2000ms); 4) negative or neutral IAPS image (8000ms); 5) valence rating prompt (until response); 6) arousal rating prompt (until response). The image shown above was selected from the OASIS images set (Kurdi, Lozano, and Banji, 2017) as a representative example and was not one of those used in the task.

Facereader AFC data processing

The video clips of participants' faces were analysed offline using Facereader 8.0 (Noldus, 2014). These data were used to provide a metric of reappraisal ability by comparing facial expressions indicative of negative affect across the watch and rethink conditions. FaceReader works in three steps. First, the program detects the presence of a face using the Viola-Jones algorithm. Next, Active Appearance Modelling (AAM; Cootes et al., 2001) is used to create a realistic face model that closely resembles the original image and provides good generalisation across various lighting conditions and poses. From this model, 500+ landmarks of different regions of the face are created and superimposed on the image as a virtual mesh. In the final stage, Facereader computes a probability/intensity score for each emotion on a scale of 0 to 1, representing the likelihood that the emotion (or neutral) expression is present. The key Facereader analysis steps are depicted in figure 5.5. The algorithm was trained using a three-layer artificial neural network with more than 10,000 instances of validated facial expression stimuli that were manually annotated by experts. For a detailed description of Facreader algorithms, see van Kuilenburg et al. (2005).

In addition to coding the probabilities/intensities of the six basic emotions, Facereader also provides a measure of valence, which is calculated as the intensity of happy expression minus the intensity of the negative expression with the greatest intensity score. Given that a range of IAPS images were used in the explicit reappraisal task, which could be expected to evoke a range of emotional responses from disgust and anger to sadness and fear, the key metric extracted from Facereader was valence. This valence metric provides a bipolar rating of the extent to which participants faces expressed positive (> 0), neutral (0), or negative (< 0) affect.

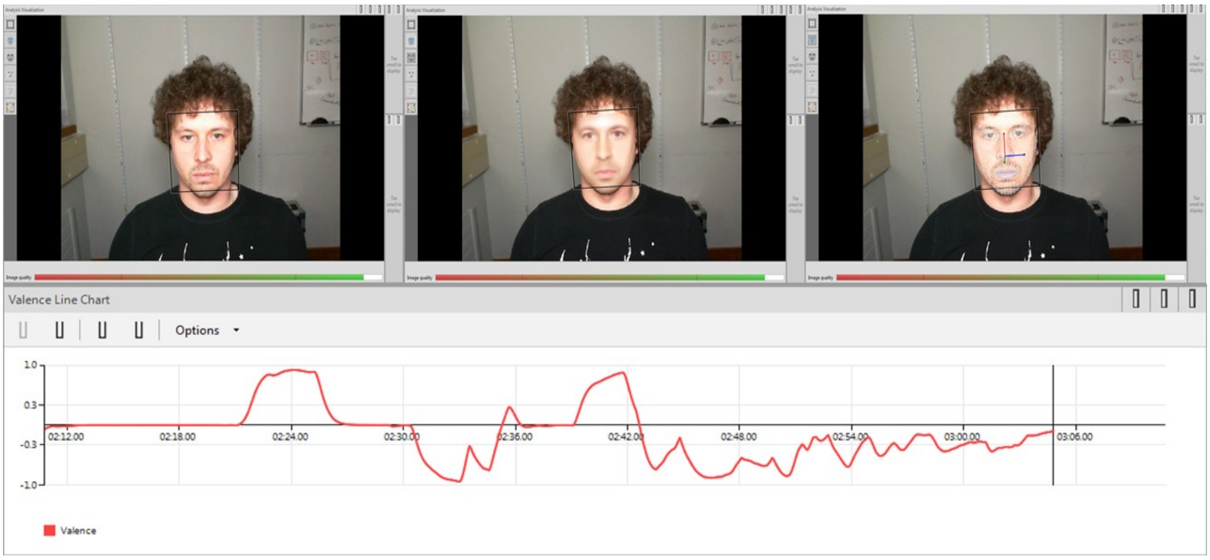

Fig. 5.5. Depiction of Facereader analysis steps. A face is detected using the Viola-Jones algorithm (top-left image); Active Appearance Modelling (AAM) is then used to create a realistic face model (top-middle image); 500+ landmarks are then identified using the AAM (top-right image). The bottom chart depicts mean valence of the face over time.

The "general" Facereader model was used, which the programme documentation states should work well under most conditions for most people. To account for biases in neutral expression, each participant was calibrated to their individual neutral baseline recorded prior to task onset. Any cells in which Facereader failed to find the face or fit the AAM were removed; any trials in which more than 50% of data points were lost were removed. To reduce the impact of any extreme data points, the raw valence values were log-transformed and any trials in which the magnitude of the valence score deviated from the mean by more than 3*SD were removed as outliers. Following these exclusions, three participants for whom a significant number of trials were lost were removed.

5.3.5. Data reduction & analyses

Following exclusion based on missing data (see section 5.3.3), a final sample of N=39 was retained for analysis. Self-report data were analysed using separate repeated measures ANOVAs with image (negative/neutral) and instruction (watch/rethink) as within-subjects factors for the dependent variables valence and arousal ratings. The AFC valence data were baseline corrected to the one second epoch preceding stimulus presentation. Given that IAPS images can take some time to decode (van Reekum et al., 2011) and the implementation of reappraisal may also take time, the mean baseline corrected AFC valence data were examined in two key epochs: An “early epoch” covering the 0-4s period following stimulus onset and the “late epoch” covering the 4-8s period post stimulus onset. These data were analysed using a repeated measures ANOVA with instruction (rethink/watch) and epoch (early/late) as within-subjects factors.

For the correlation analysis, the following metrics were extracted from the explicit reappraisal task as measures of reappraisal ability (i.e. the extent to which participants experienced a reduction in negative emotion in the rethink compared to the baseline watch condition). For self-reported valence, the key metric was the difference between the watch and rethink conditions, which was calculated by subtracting the mean valence rating in the watch condition from the mean valence rating in the rethink condition. For arousal ratings, this metric was calculated by the inverse subtraction

(i.e. mean arousal watch - mean arousal rethink), as higher arousal scores would be expected in the watch relative to the rethink condition.
For the AFC data, the mean baseline corrected valence score in the early and late epochs for the watch condition were subtracted from the mean baseline corrected valence score in the corresponding epochs of the rethink condition. For all of these metrics a larger value reflects a greater magnitude of reduction in negative emotion following reappraisal.

Normality of each variable was assessed using Kolmogorov-Smirnov tests. Spearman's rho is reported for any correlations where at least one variable distribution showed significant deviation from normality. All tests were 2-tailed with a significance threshold of $p < .05$. To ensure that the observed results were not unduly influenced by a small number of outlier cases, the same analyses reported in the results section were conducted following the removal of univariate and bivariate outlier cases (see appendix G). While not related to the main hypothesis of this study, the correlations between ERQ reappraisal use and the implicit and explicit reappraisal task metrics are reported in appendix G.

5.3.6. Results

Self-report ratings

Valence ratings

A repeated measures ANOVA with emotion (neg/neu) and instruction (rethink/watch) demonstrated a significant main effect of emotion, $F(1, 38)$

$= 274.80$, $p < .001$, partial $\eta^2 = .88$, and a significant main effect of instruction, $F(1, 38) = 15.75$, $p < .001$, partial $\eta^2 = .29$. A significant emotion by instruction interaction was also observed, $F(1, 38) = 13.37$, $p = .001$, partial $\eta^2 = .26$.

Post-hoc comparisons with Bonferroni adjustment demonstrated that mean valence ratings were lower (i.e. more negative) for negative relative to neutral images ($p < .001$), and for the watch relative to rethink condition ($p < .001$). For negative images, mean valence ratings were lower in the watch relative to the rethink condition ($p < .001$). There was no difference in valence ratings in the rethink compared to the watch condition for neutral images ($p = .50$) (fig. 5.6, left panel).

Arousal ratings

A repeated measures ANOVA with emotion (neg/neu) and instruction (rethink/watch) demonstrated a main effect of emotion, $F(1, 38) = 201.14$, $p < .001$, partial $\eta^2 = .84$. The main effect of instruction was not significant, $F(1, 38) = .02$, $p = .88$, partial $\eta^2 = .001$, however, there was a significant emotion by instruction interaction, $F(1, 38) = 19.58$, $p < .001$, partial $\eta^2 = .34$.

Post-hoc comparisons with Bonferroni adjustment demonstrated that arousal ratings were higher for negative relative to neutral images ($p < .001$). For negative images, arousal ratings were lower in the rethink relative to the watch condition ($p < .001$), however, arousal ratings were higher in the rethink compared to watch condition for neutral images (p = .01) (see fig. 5.6, right panel).

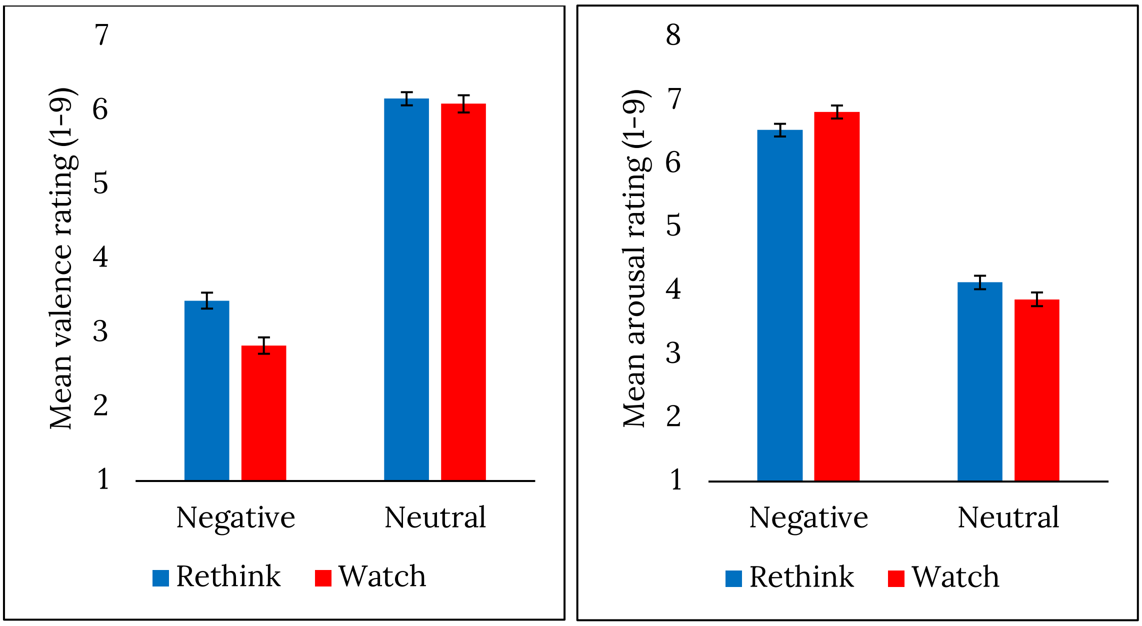

Fig. 5.6. Mean valence (left panel) and arousal (right panel) ratings for negative and neutral images across each condition in the explicit reappraisal task. Error bars depict ± 1 within-subjects SEM.

Analysis of Facereader AFC valence data

A paired samples t-test demonstrated that the mean baseline corrected valence of facial expressions was lower (i.e. more negative) for negative relative to neutral images, $t(38) = 2.43$, $p = .02$ (fig. 5.7). This provides support for the assertion that the Facereader valence metric is capturing facial states relevant to negative affect induced by the IAPS images.

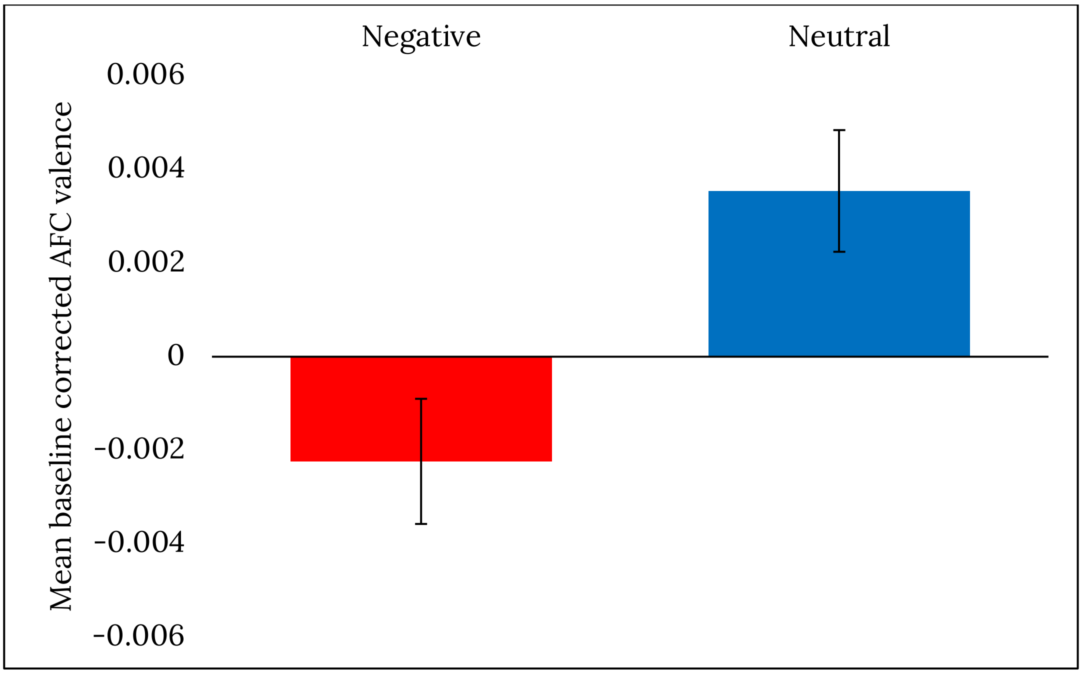

Fig. 5.7. Mean baseline corrected AFC valence scores for negative and neutral images. Error bars depict ± 1 within-subjects SEM.

A repeated measures ANOVA with instruction (rethink/watch) and epoch (early/late) found that the main effect of instruction failed to reach significance, $F(1, 38) = 1.85$, $p = .18$, partial $\eta^2 = .05$. While the main effect of epoch was approaching significance, $F(1, 38) = 3.62$, $p = .07$, partial $\eta^2 = .09$, the instruction by epoch interaction was not significant $F(1, 38) = 1.74$, $p = .20$, partial $\eta^2 = .04$.

While the instruction by epoch interaction was not significant, the data showed patterns in the expected direction, which were further explored using post-hoc pairwise comparisons with Bonferroni correction. While there was no difference between the watch and rethink conditions in the early epoch ($p = .52$), there was a trend-level difference between these conditions in the late epoch ($p = .11$). Further, while there was no difference between the early and late epochs in the rethink condition (p = .21), valence was lower at trend-level in the late compared to early epoch for the watch condition (p = .06) (fig. 5.8). For illustrative purposes the mean baseline corrected AFC valence for each one second epoch of the image presentation period are shown in figure 5.9.

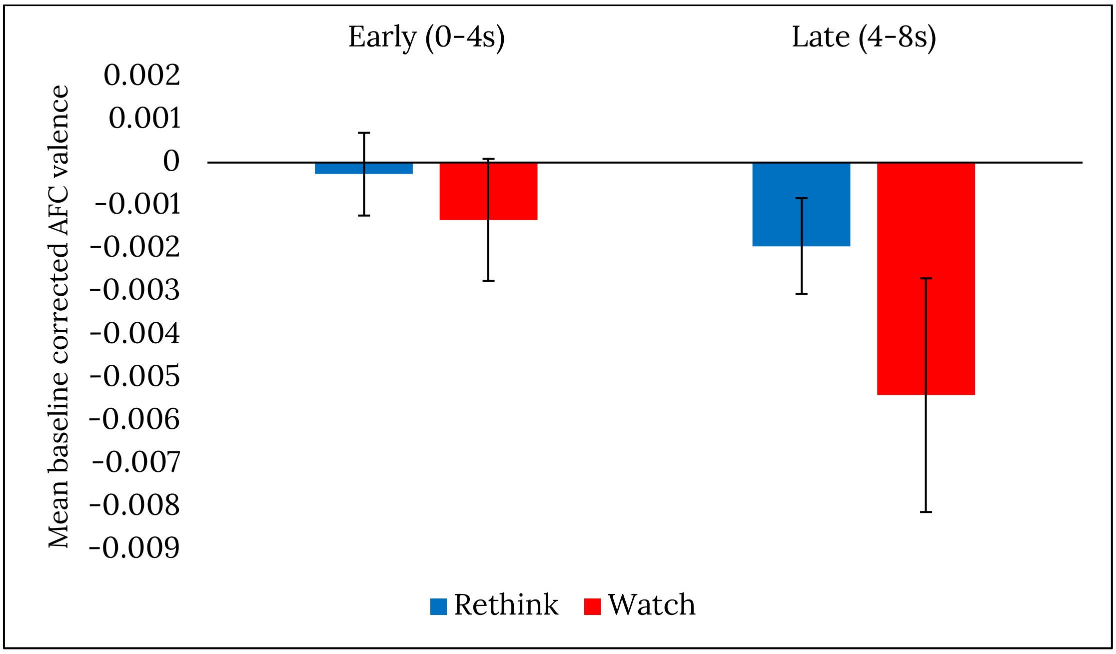

Fig. 5.8. Mean baseline corrected AFC valence scores in the early (0-4s) and late (4-8s) epochs of the image presentation period for the watch (red) and rethink (blue) conditions. Error bars depict ± 1 within-subjects SEM.

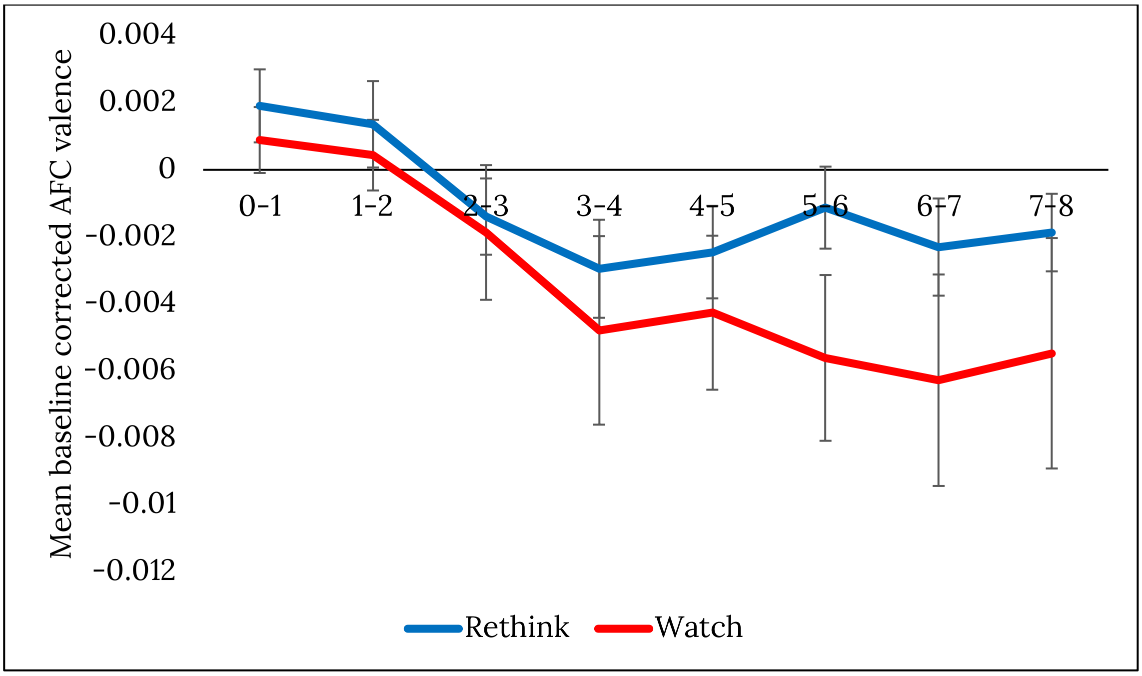

Fig. 5.9. Mean baseline corrected AFC valence scores in each 1 second epoch of the image presentation period for the watch (red) and rethink (blue) conditions. Error bars depict ± 1 within-subjects SEM.

Relationship between trait empathy and explicit reappraisal metrics

Self-report metrics

The valence rating reappraisal metric was not significantly related to trait cognitive (*rho*(37) = -.15, *p* = .35) or affective (*rho*(37) = .15, *p* = .36) empathy. These two correlations were not significantly different (Steiger's Z = -.15, *p* = .14). The arousal rating reappraisal metric showed a trend-level negative relationship with trait cognitive empathy, *rho*(37) = -.29, *p* = .07. This arousal metric showed no relationship with trait affective empathy, *rho*(37) = .10, *p* = .57. The difference between these correlations was on the threshold of significance, Z = -1.94, *p* = .05 (fig. 5.10).

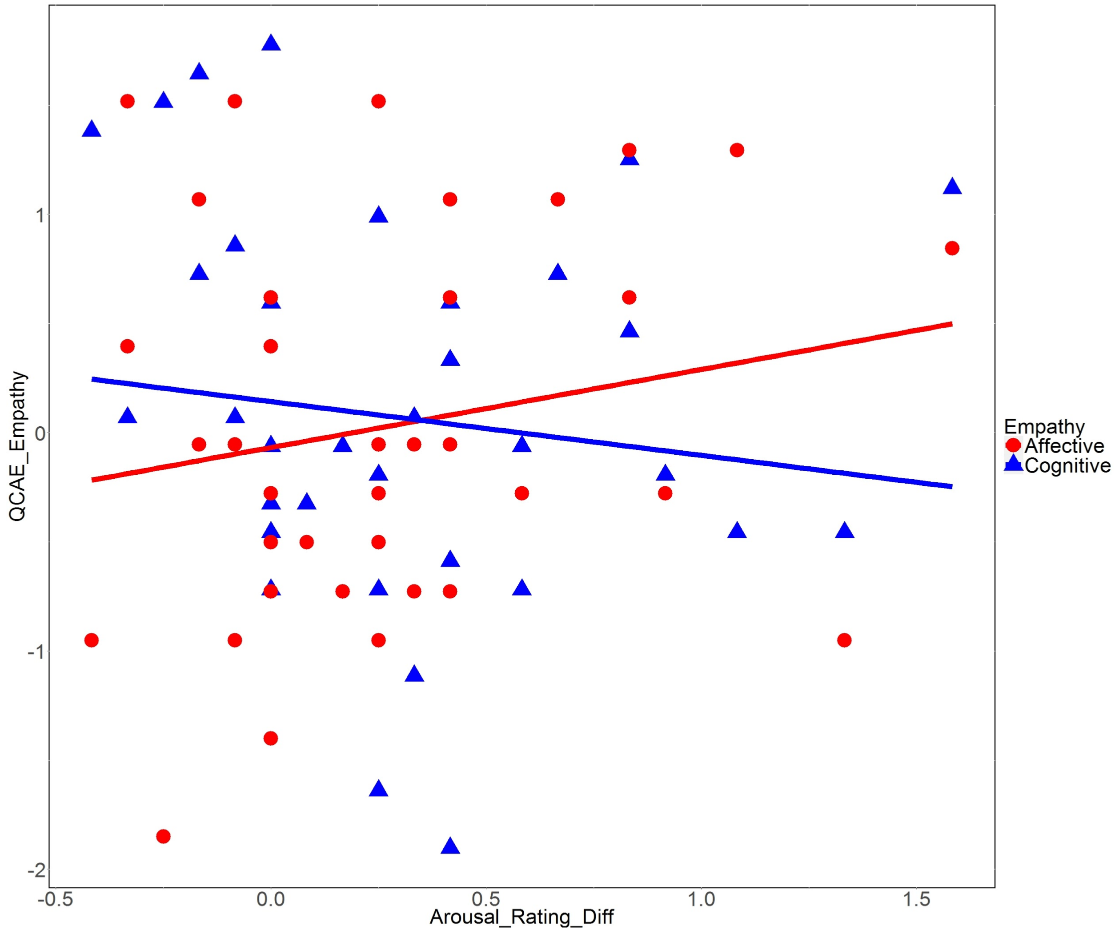

Fig. 5.10. Scatterplot showing the relationship between explicit reappraisal task arousal rating difference (watch - rethink) and z-transformed cognitive and affective empathy. Affective empathy (red) was not significantly related to the arousal difference metric; cognitive empathy (blue) showed a negative correlation with the arousal difference metric that was approaching significance.

Facereader AFC valence metrics

Trait cognitive empathy showed a negative correlation with the AFC valence reappraisal metric in the early epoch, *rho*(37) = -.32, *p* = .047. Trait affective empathy was not significantly related to the AFC valence reappraisal metric in the early epoch (*rho*(37) = .17, *p* = .30). These correlations were significantly different, Z = -2.44, *p* = .01 (fig. 5.11). Both cognitive and affective empathy showed no significant relationship with this metric in the late epoch, *rho*(37) = -.01, *p* = .96. or late (*rho*(37) = .21, *p* =

.21). A Steiger's test confirmed that these two correlations were not significantly different, Z = -1.08, p = .28).

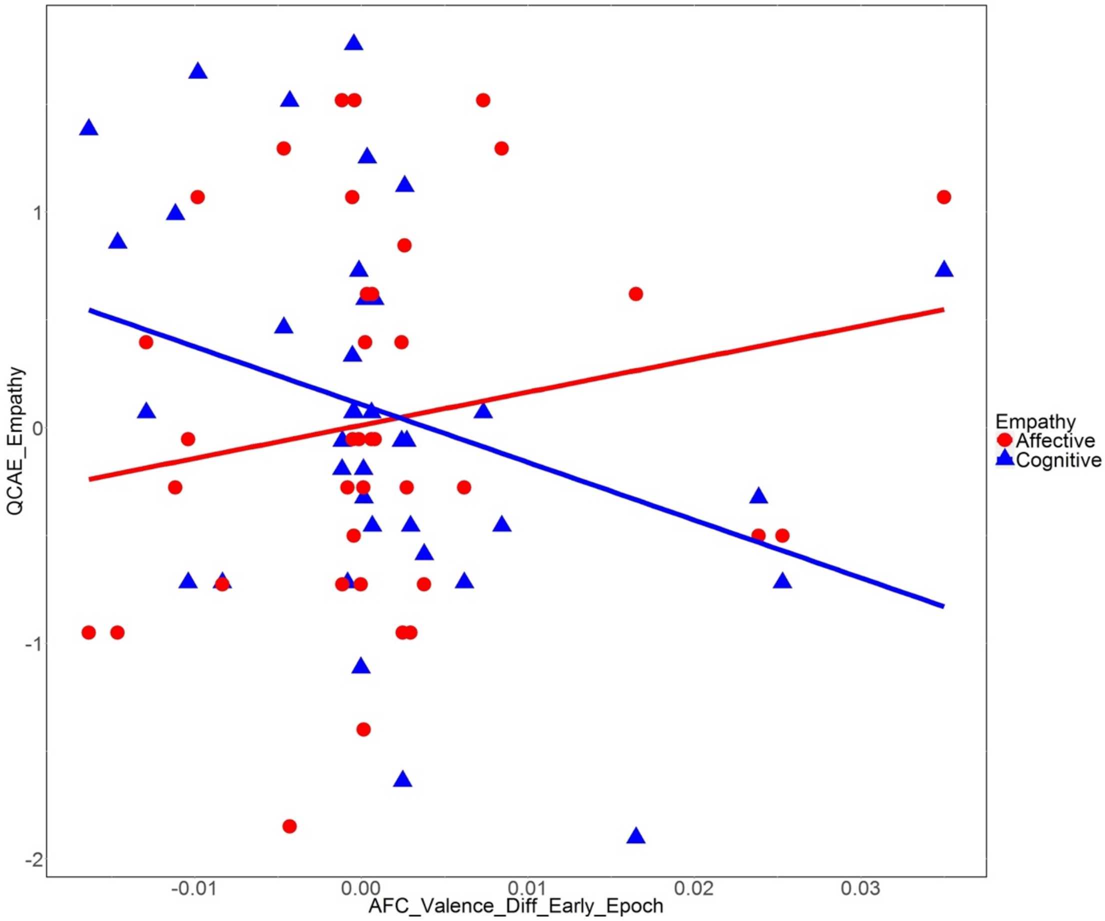

Fig. 5.11. Scatterplot showing the relationship between the explicit reappraisal task AFC valence score difference in the early epoch (baseline corrected rethink - watch condition) and z-transformed cognitive/affective empathy. The AFC valence metric was negatively correlated with cognitive empathy (blue) but was not significantly related to affective empathy (red).

5.4. General discussion

5.4.1. Summary of findings

Across two studies it was observed that the cognitive and affective dimensions of trait empathy share different relationships with metrics assessing the magnitude of negative emotion downregulation in an implicit (study 1) and explicit (study 2) reappraisal task. Contrary to the study hypotheses, trait cognitive empathy was not related to improved reappraisal ability in either study. Cognitive empathy showed no relationship with an implicit reappraisal task metric, a trend-level negative relationship with self-reported arousal change, and a negative relationship with an AFC metric of regulation magnitude in an explicit reappraisal task. While no relationship was observed between trait affective empathy and the explicit reappraisal task metrics, higher affective empathy was associated with a greater magnitude of emotion downregulation in the implicit reappraisal task. I now discuss some potential interpretations of these results in relation to prior theoretical and empirical work.

5.4.2. Cognitive empathy & reappraisal

The prediction of a positive relationship between cognitive empathy and reappraisal ability was based on evidence that processes associated with the cognitive component of empathy show overlap with those recruited during reappraisal (Buhle et al., 2014; Carlson et al., 2004; Dennis et al., 2009; Goldin et al., 2008; Hendricks and Buchanan, 2016; Messina et al., 2015; Saxe et al., 2004; Webb et al., 2012a). Given this overlap, one might infer that a greater capacity for one ability is similarly associated with a greater capacity for the other. Furthermore, component processes associated with cognitive empathy, such as perspective-taking/self-other control, may support reappraisal in more specific ways. Aside from the dominant usage of the term reappraisal as referring to a change in meaning attributed to an emotional stimulus, reappraisal can also entail cognitive change via self-distancing (or reappraisal via perspective-taking) (Kross and Ayduk, 2008; Messina et al., 2015; Webb et al., 2012a).

Self-distancing (henceforth, distancing) involves taking a detached perspective from one's immediate egocentric experience (Cocking and Renninger, 1993; Ochsner et al. 2004; Trope and Liberman, 2010), and has been shown to be effective in modulating emotion based on self-report and physiological/neural metrics (Ayduk and Kross, 2010; Davis et al., 2011; Kross et al., 2005, 2012; Ochsner et al., 2012). While a distinct form of reappraisal in its own right, distancing could also support semantic reappraisal, as the ability to distance oneself from the more concrete aspects of one's current experience may be conducive to self-reflection (Davis et al., 2011; Gruber et al., 2009; Katzir and Eyal, 2013; Kross and Ayduk, 2011; Ochsner and Gross, 2008; Wisco and Nolen-Hoeksema, 2011), thereby facilitating the generation of reappraisals in the service of emotion regulation (Wallace-Hadrill and Kamboj, 2016). Indeed, there is evidence to suggest that distancing can facilitate the positive reconstrual of life stressors (Kross and Ayduk, 2008; Kross et al., 2012).

The concept of distancing is conceptually similar to perspective-taking in that both involve a shift in one's perspective. Consequently, one could argue that the ability to shift between self and other perspectives (a component process of cognitive empathy) might facilitate the process of distancing oneself from the ongoing emotional experience in order to modulate one's response using semantic reappraisal. Furthermore, as the emotional stimuli used in these studies were all of a social nature, distancing oneself from the emotional experience in order to generate new and/or subdominant meanings may necessitate being able to efficiently detach oneself from the perceived other's perspective.

With the above interpretation in mind, the unexpected finding that cognitive empathy was negatively related to metrics of reappraisal ability in the explicit task could be due to the way in which the empathy measure used in this study relates to this particular task. In the current studies, cognitive empathy was assessed only by trait measures, which capture an individual's perceived abilities and motivation/propensity to engage empathic processes (Gehlbach, 2004; Keysers and Gazzola, 2014). It is possible that a greater motivation or disposition to take others' perspectives may impede the processes necessary to regulate one's emotions via reappraisal in the case of social stimuli. Consequently, the finding that higher trait cognitive empathy was negatively associated with reappraisal ability in this task could suggest that it takes longer for individuals with a heightened propensity to engage cognitive empathic processes to detach from the other's perspective in order to reappraise the stimulus in a manner that elicits a reduced emotional response. This speculative interpretation highlights an important question as to whether one's ability and propensity for empathy may be differentially related to their emotion regulation abilities.

Additionally, there is evidence to suggest that individuals with high trait empathy show an increased preference for social vs. non-social stimuli (Hedger et al., 2018), and pay more attention to social stimuli such as faces (Choi and Watanuki, 2014). Thus, it is possible that the negative relationship between cognitive empathy and metrics of regulation magnitude in the explicit reappraisal task were driven by a heightened tendency to attend to the affective stimuli, which could have reduced the availability of cognitive resources necessary to effectively implement reappraisal.

5.4.3. Affective empathy & reappraisal

Individuals with higher trait affective empathy showed an increased magnitude of emotion downregulation in an implicit reappraisal task, which suggests that affective empathy may support the ability to implicitly update one's emotional appraisals based on extrinsic contextual information. Reappraisal frames are thought to exert their influence over emotional responses in a relatively implicit manner (Foti and Hajcak, 2008; Wang et al., 2017). Similarly, affective empathy is thought to involve largely implicit processing of emotional information (Chartrand and van Baaren, 2009;

Niedenthal, 2007; Preston and de Waal, 2002). Hence, the association between implicit reappraisal and affective empathy is not entirely surprising given that both abilities relate to implicit emotional processes. The results of study 2 found no evidence for any relationship between trait affective empathy and regulation magnitude in an explicit reappraisal task.

Taken together these findings suggest that affective empathy may support the ability to implicitly update one's initial appraisals of a stimulus based on extrinsic contextual information; however, it does not facilitate the regulation of emotion via reappraisal in instances where one must self-generate potential reappraisal narratives. While there is overlap in the brain regions associated with explicit and implicit reappraisal, explicit reappraisal represents a more cognitively demanding task (due in part to the recruitment of cognitive control and semantic processes required to construct potential reappraisal narratives) (Messina et al., 2012; Ochsner and Gross, 2005; Wang et al., 2017; Webb et al., 2012a). Thus, even though higher levels of affective empathy may support the implicit process of updating one's initial emotional appraisals, it may not confer any advantage in instances where reappraisal is dependent upon more demanding cognitive control processes.

Furthermore, it is possible that the heightened arousal that individuals with greater trait affective empathy experience in response to others' emotions (Rueckert et al., 2011; Sonnby-Borgstrom, 2002) results in increased emotional interference on cognitive control abilities (Hare et al., 2005; Tottenham et al., 2011), which may reduce the ability to effectively engage more demanding reappraisal processes. Consequently, any advantage that affective empathy may confer in terms of updating one's emotional appraisals on an implicit level might be negated in more demanding situations by the deleterious effects of increased emotional reactivity on vital cognitive control processes.

5.4.4. Summary, conclusions, and limitations

The two studies reported in this chapter found some evidence to support the hypothesis that the cognitive and affective dimensions of empathy share different relationships with reappraisal ability. However, the relationships that cognitive and affective empathy shared with reappraisal ability were contrary to the study hypotheses. There was no evidence to suggest that cognitive empathy was associated with improved reappraisal ability in either study. Furthermore, while affective empathy was unrelated to task metrics of explicit reappraisal, it showed a positive relationship with a task metric of implicit reappraisal.

It is important to highlight certain limitations of the current studies, and how these will be addressed in the final empirical chapter. A caveat of study 1, which is shared with many studies on emotion regulation, is that the metric of implicit reappraisal was based on self-report data. While it is possible that socially desirable responding and/or demand characteristics could have played some role in the observed effects, a number of steps were taken to reduce the potential for such confounds. Firstly, participants were recruited for a study on “mood and cognitive performance“ and there was no mention of emotion regulation during the lab testing session. Additionally, the experimenter was not present in the room during task completion and participants were explicitly informed that their data would be analysed anonymously and were instructed to respond accurately and honestly. As such, there is no reason to infer that such confounds were likely to have influenced the observed results in any demonstrable way.

Study 2 supplemented self-report metrics with a more objective measure of emotional experience based on Facereader AFC ratings of facial expression valence. The approach showed some promise as a tool for assessing emotional reactivity/regulation, demonstrating sufficient sensitivity to detect differences in facial expression valence between negative and neutral images. However, while the observed effects of regulation instructions showed a pattern in the expected direction, these were small in magnitude and failed to reach significance.

Visual inspection of the video data revealed that to the human eye, participants for the most part showed relatively stable neutral expressions throughout the task. Thus, while Facereader was able to detect some differences between the regulation conditions it may lack the sensitivity required to detect such subtle differences in facial states. To maximise the utility of AFC analyses in this context it may be useful to use more intense/graphic stimuli than those used in the current study. In the study reported in the next chapter, facial EMG measures of corrugator activity were used to enable greater sensitivity to detect subtle changes in muscle activity associated with emotional expression/experience.

Both studies in this chapter used only trait measures of cognitive and affective empathy. Given prior work highlighting the importance of distinguishing between one's ability and propensity to engage empathic processes (Cameron et al., 2019; Gehlbach, 2004; Keysers and Gazzola, 2014; Zaki, 2014), coupled with evidence of inconsistent patterns of convergence between trait and task measures of empathy (Melchers et al., 2015; Murphy and Lilienfeld, 2019), it would be worthwhile to examine these relationships using a range of empathy measures. In the next chapter, I examine the relationship between a task measure of emotion regulation and a combination of trait and task empathy measures. This approach should enable greater clarity regarding the relationship between emotion regulation ability and one's propensity and ability for engaging different component processes of empathy.

Finally, while reappraisal is typically considered an adaptive regulation strategy, its efficacy in modulating emotion may be dependent upon various contextual factors (Aldao, 2013; Aldao and Nolen-Hoeksema 2012; Suri et al., 2018). For example, regulating emotions via semantic reappraisal may be easier and more effective in the context of the death of an elderly relative following a protracted illness compared to the tragic death of a young relative. Adaptive emotion regulation is dependent not only upon an individual's ability to implement a given strategy, but also their ability to select a suitable strategy for a given context (Aldao, 2013, Bonanno and Burton, 2013; Gross, 2015; Sheppes and Levin, 2013; Urry and Gross, 2010). This selection component of emotion regulation (Gross, 2015) is not captured by paradigms such as those used in study 2, where participants are instructed to use only one particular strategy throughout. To provide greater consideration of strategy selection, the task reported in the next chapter used an instructed regulation paradigm in which participants were free to select any strategy of their own choosing across regulation trials.

Chapter 6

Trait/task measures of empathy and their relationship with spontaneous and instructed emotion regulation

6.1. Introduction

In acknowledgement of the limitations of instructed emotion regulation tasks discussed in the previous chapter discussion, this chapter reports a study that used a more ecologically valid regulation paradigm that assessed the ability to select and implement an appropriate regulatory strategy (Gross, 2015). To enable greater clarity regarding the relationship between emotion regulation and one's motivation and ability to engage different cognitive and affective empathic processes, empathy was assessed using a combination of trait and task measures. Furthermore, in addition to assessing instructed emotion regulation magnitude using self-report and facial electromyography (EMG), this task used corrugator EMG measures to assess participants' spontaneous emotional recovery following exposure to negative stimuli.

6.1.1. Regulation strategy selection

The vast majority of instructed emotion regulation paradigms specify the particular strategy (or strategies) to be used across all regulation trials (e.g. Ochsner et al., 2004a). While useful for characterising the affective consequences and neutral substrates of different strategies, such paradigms may not provide a wholly accurate reflection of participants' true regulatory abilities. For example, instructing the use of a given strategy, such as reappraisal, may artificially improve the regulatory performance of individuals, who left to their own devices might have selected a less adaptive strategy such as suppression. Conversely, such paradigms could also artificially decrease the regulatory performance of strong regulators, who may otherwise have used a different strategy that might have been more effective than reappraisal in a particular context. Furthermore, such tasks do not allow participants to utilise multiple strategies simultaneously, or switch to a different strategy following initial failures to achieve the desired emotion state, which may be common occurrences in day-to-day regulation (Aldao and Nolen-Hoeksema, 2012; Gross, 2015).

In sum, by instructing and training participants to use a particular strategy, many regulation paradigms enable the assessment of only the implementation stage of the regulation process and do not capture other processes critical for adaptive regulation. One such process is the capacity to select an appropriate strategy suitable for a given context and/or emotional experience. While some prior studies have used tasks in which participants are able to choose how they regulate their emotional response, such studies typically restricted participants to choosing between a limited set of strategies, such as reappraisal and distraction (Scheibe et al., 2015; Sheppes et al., 2011).

To obtain a more accurate and holistic measure of an individual's true regulatory abilities, research should utilise tasks in which participants are not given any detailed training in the use of a particular regulation strategy and where they are free to choose the means by which they regulate their emotions in response to different stimuli (Baur et al., 2015). Given that the effectiveness of real-world emotion regulation is dependent upon the ability to flexibly adapt one's regulatory actions to meet situational demands (Bonanno et al., 2004; Gross, 2015), a free choice regulation task may provide a more ecologically valid assessment of emotion regulation abilities (Baur et al., 2015; Optiz et al., 2015).

6.1.2. Instructed versus spontaneous emotion regulation

A further limitation of instructed regulation tasks is that they assess only the more explicit and intentional forms of emotion regulation. While conscious and intentional processes may be common in real-world emotion regulation (Ochsner and Gross, 2005, 2008; Tice and Bratslavsky, 2000), more spontaneous and effortless regulatory processes are also likely to play an important role in managing emotions day-to-day (Gyurak et al., 2011; Mauss et al., 2007; Williams et al., 2007).

Implicit or spontaneous emotion regulation (SER) is typically defined as the modulation of any aspect of emotion, such as subjective experience, emotional expression and/or physiology, in the absence of any conscious awareness or explicit intention to alter one's emotional state (Mauss et al., 2007; Mocaiber et al., 2011; Morillas-Romero et al., 2015; Williams et al., 2007). There is evidence to suggest that difficulties in spontaneously downregulating negative emotions are associated with increased trait negative affect and anxiety (Egloff et al., 2006), diminished emotional wellbeing (Hopp et al., 2011), and increased vulnerability for developing depression (Ehring et al., 2010).

The importance of examining SER in addition to more explicit forms of regulation is further highlighted by studies which have found a lack of convergence between instructed regulation tasks and typical day-to-day experiences with emotion regulation. For example, one study found that while individuals with bipolar disorder experience significant difficulties with emotion regulation in daily life (Gruber et al., 2013), such difficulties are not always evident in instructed regulation tasks (Gruber et al., 2009). However, when assessing more spontaneous forms of emotion regulation in the laboratory environment the expected deficits may be observable (Depue et al., 1985).

SER has been assessed by prior work in various ways, commonly by comparing self-report ratings and/or physiological metrics of affect before and after emotional induction (Aldao et al., 2013; Egloff et al., 2006; Ehring et al., 2010; Volokhov and Demaree, 2010), and/or examining how these metrics are modulated by individual differences in self-reported habitual strategy use. One issue with such approaches is that it may be difficult to determine the extent to which such changes reflect variability in SER versus emotional reactivity. In this study, fEMG measured corrugator activity is used to assess the efficiency of spontaneous emotional recovery (independent of emotional reactivity) following exposure to negative emotional stimuli, as done in previous studies (Lapate et al., 2014; van Reekum et al., 2011).

6.1.3. The current study

While the hypothesised relationship between cognitive empathy and reappraisal ability was not observed in the previous chapter, this could in part be due to the aforementioned limitations of instructed regulation paradigms. While it could simply be that cognitive empathy is positively associated with the propensity but not the ability to use reappraisal, it is possible that cognitive empathy could support emotion regulation through the ability to select and monitor the influence of regulatory processes, rather than the ability to implement them per se. To examine this possibility the current study utilised an instructed regulation paradigm in which participants were free to regulate their emotions using any strategy of their choosing. Furthermore, this task also enabled the examination of the relationship between empathy and spontaneous emotional recovery, an aspect of emotion regulation that has been largely overlooked by prior work in favour of more explicit forms of regulation.

Regulation magnitude was assessed using a combination of self-report ratings and fEMG-measured corrugator activity, which has been shown to provide a reliable indication of emotional reactivity/regulation (Jackson et al., 2000; Lapate et al., 2014; van Reekum et al., 2011; Wu et al., 2012). Given evidence of a link between day-to-day regulation habits (e.g. habitual strategy use) and task-based metrics of SER (Drabant et al., 2009), it was predicted that cognitive empathy (which was found in chapters 2 and 3 to be associated with increased reappraisal use) would be associated with more efficient spontaneous emotional recovery following the offset of negative affective stimuli. It was also predicted that cognitive empathy would be positively related to metrics of instructed regulation magnitude. In the previous chapter, affective empathy was positively correlated with the magnitude of downregulation in an implicit, but not an explicit, reappraisal task. Consequently, it was predicted that affective empathy would be positively associated with spontaneous emotional recovery but show no relationship with metrics of instructed regulation.

To enable greater clarity regarding the relationship between emotion regulation abilities and one's motivation and ability to engage different empathic processes, empathy was assessed using a combination of trait and task measures. As in prior chapters, trait empathy was assessed using the QCAE, with more objective measures of these abilities assessed using the director task and spontaneous facial mimicry task reported in chapter 3.

6.2. Methods

6.2.1. Participants

The same N = 48 participants who completed the empathy tasks reported in chapter 3, also completed the spontaneous and instructed regulation task (see section 3.2.1 for sample demographics). Data for two participants were removed from the regulation task (see data reduction and analysis section for details), leaving a final sample of N = 46 on which all analyses were performed.

6.2.2. Materials

Trait empathy. Trait empathy was assessed using the QCAE (Reniers et al., 2011).

Task measures of empathy. Two task measures of empathy were used in the current study. A component process of cognitive empathy was assessed using the director task, with an eye-tracking metric reflecting the relative gaze time on the target vs. foil object used as a measure of perspective-taking ability. A component of affective empathy was assessed EMG-measured spontaneous facial mimicry (SFM), which provides a proxy measure of participants' capacity to resonate others' emotional states (see section 3.2.2 for further details of these tasks/metrics).

Affective images. Sixty social images (45 negative, 15 neutral) were selected from the IAPS database (Lang et al., 2005) (see appendix H for IAPS image numbers). As in prior chapters, while the main analysis focused upon the negative images, neutral images were included in the first block as a manipulation check and as a means of slowing habituation to negative images. An independent samples t-test confirmed that the mean normative valence ratings for negative images (M = 2.36, SD = 0.57) were significantly lower than for neutral images (M = 5.20, SD = 0.62), $t(58) = 16.42$, $p < .001$. Negative images also had a significantly higher mean normative arousal rating (M = 5.69, SD = 0.80) compared to the neutral images (M = 3.59, SD = 0.49), $t(58) = 9.53$, $p < .001$.

Three sets of 15 negative images were created for counterbalancing purposes. Block 1 comprised one set of negative images alongside 15 neutral images; block 2 comprised the other two sets of negative images, each of which was paired with a different regulation instruction ("attend" or "regulate"). The condition in which each negative image set was used was counterbalanced across the sample. Image sets were matched based on mean normative valence and arousal ratings (Lang et al., 2005), image category, complexity, and social content. Independent samples t-tests demonstrated that there were no significant differences in mean normative valence/arousal ratings across each negative image set (all $p >= .85$).

6.2.3. Procedure

Questionnaires were completed online and the regulation task as part of a lab session, which also included the empathy tasks reported in chapter 3 (order of task completion was counterbalanced across the sample). The regulation task lasted approximately 20 minutes and comprised two blocks: (1) a spontaneous reactivity/recovery block, and (2) an instructed regulation block. The spontaneous block was always completed first. Participants were told that they would be shown a series of images and would subsequently be asked questions regarding how each image made them feel (see appendix H for full instructions). Block one comprised 30 trials (15 negative images, 15 neutral images). Participants responded to each image by rating how unpleasant/pleasant it made them feel (i.e. valence), and how arousing they found the image. Both ratings were provided using a 9-point scale, where in the case of valence: 1 = extremely unpleasant, 5 = neither pleasant nor unpleasant, 9 = extremely pleasant, and in the case of arousal: 1 = not at all arousing, 9 = extremely arousing. The rating scales were the same for block 1 and block 2, and on each trial the question and accompanying rating scale remained on screen until participants made their response using the 1-9 keys on the keyboard.

Participants were instructed that they should attend to the images for the entire time they are presented. As in chapter 5, participants were informed that all of the images depicted real people in real situations. Following completion of the first block, participants were able to take a short break if they wished and were then given instructions for the second task block. Participants were informed that prior to seeing each image, one of two possible instruction words would be presented on screen. Half of the images were preceded by the word “attend”, and the other half by the word “regulate”. Participants were instructed that when the word is “attend” they should let any thoughts/feelings unfold as they naturally would. For regulate trials, participants were instructed that they should try to downregulate any negative emotion the image evokes.

In contrast to prior studies where participants are typically instructed to use a particular strategy, in this task participants were free to regulate their emotions using any strategy of their choosing on each trial. The only restriction was that they should not close their eyes or look away from the image. Prior to commencement of the second block, participants completed three practice trials for the regulate condition. Following each practice trial, the experimenter checked that they were able to utilise a feasible regulation strategy. A schematic of trials events in the instructed block is depicted in figure 6.1 (spontaneous block trials comprised the same sequence of events, only excluding the instruction screen prior to image onset).

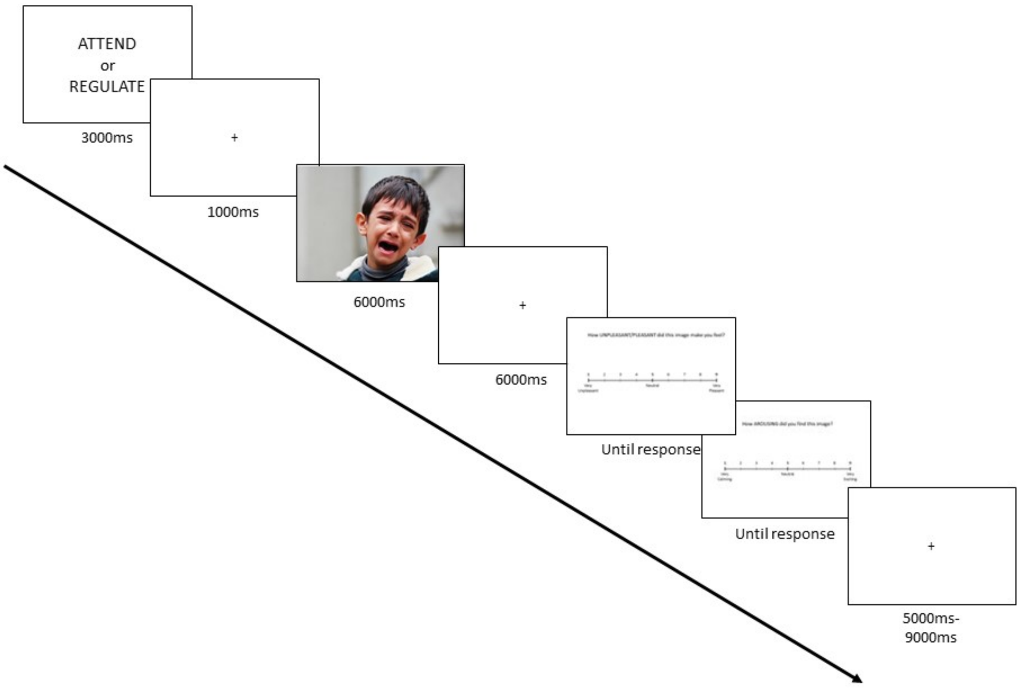

Fig. 6.1. Schematic of trial events in the instructed regulation block. Trials consisted of the following sequence of events: 1) trial instruction (attend or regulate); pre-image fixation (during which the baseline corrugator activity was measured); 3) stimulus (negative or neutral IAPS image); 4) post-image fixation (recovery period); 5) valence rating screen; 6) arousal rating screen; 7) jittered ITI fixation screen. The trial events for the spontaneous block were exactly the same as above, however there was no instruction screen at the beginning of each trial.

Facial EMG recording and processing

EMG activity was measured using sensors positioned over the corrugator supercilii in accordance with the guidelines proposed by Fridlund and Cacioppo (1986). The skin was cleaned using 70% alcohol wipes, after which 4mm Ag/AgCl surface sensors (Discount Disposables, USA) filled with isotonic electrode gel (Mansfield R&D, UK) were attached bipolarly to the left side of the face using 5mm collars (Discount Disposables) at a distance of 10mm apart. A ground electrode was positioned over the left mastoid process. The EMG signal was recorded using an ML-870 Power Lab, amplified 10,000 times by an ML-138 Octal Bioamp and recorded/processed using LabChart 8 (AD Instruments). The raw EMG signal was sampled at a rate of 1kHz, digitized with 16-bit precision. Digital 500 Hz low-pass and 50 Hz high-pass filters were applied offline.

EMG data were visually inspected for any movement artefacts/noise, following which they were rectified and logarithmically transformed to remove negative values and minimize the impact of any extreme values. The magnitude of EMG activity during the image presentation epoch and recovery (post image-offset) epoch were baseline corrected by dividing the mean activity by the mean activity within a one second baseline fixation period preceding each image (de Wied et al., 2009).

6.2.4. Data reduction and analyses

One participant was removed due to poor quality EMG recording, and one participant with incomplete questionnaire data was also removed. This left a final sample of N = 46, which was subject to analysis. To reduce the influence of data outliers, any trials in which corrugator activity deviated from the mean by more than 3*SD were removed. Following all artefact and outlier trial removal the mean number of trials (± SD) from which the fEMG metrics were calculated was: negative image trials (M = 14.41 ± 1.20); neutral image trials (M = 14.93 ± 0.25). The mean baseline corrected corrugator activity was assessed in two epochs: (1) the "reactivity" epoch comprised the 6 second period during which an affective image was present on screen; (2) the "recovery" epoch comprised the 6 second fixation screen period that immediately followed image offset.

Self-report ratings of valence and arousal were examined using paired samples t-tests, which compared: (1) the negative and neutral image conditions in the spontaneous block, and (2) the regulate and attend conditions in the instructed block. Corrugator EMG data were analysed using a repeated measures ANOVA with emotion (negative/neutral) and epoch (baseline/reactivity/recovery) as within-subjects factors in the spontaneous block, and a repeated measures ANOVA with instruction (attend/regulate) and epoch (baseline/ reactivity/recovery) as within-subjects factors in the instructed block.

The metric of spontaneous recovery following exposure to negative emotional images, was the baseline corrected corrugator activity within the recovery epoch (i.e. the 6 second fixation epoch following image offset). In alignment with prior studies (e.g. van Reekum et al., 2011), to render this recovery epoch independent from emotional reactivity, the baseline corrected corrugator activity within the recovery epoch was regressed against the baseline corrected corrugator activity within the reactivity epoch. The residuals were then saved as a new variable, which was used in the correlation analysis. As lower values for this residualised recovery metric actually reflected a greater magnitude of recovery, for the sake of clarity, these values were reversed such that higher values reflect a greater magnitude of recovery.

Instructed regulation was assessed based on the difference in self-reported valence and arousal ratings for negative images in the regulate and attend conditions (block 2). So that a higher value on each metric reflects a greater magnitude of emotion downregulation, these metrics were calculated in the following way:

Arousal regulation metric = mean attend rating - mean regulate rating

Valence regulation metric = mean regulate rating -mean attend rating

The corrugator metrics of instructed regulation magnitude were calculated by subtracting the mean baseline corrected corrugator activity within the reactivity (0-6s following image onset) and recovery (0-6s following image offset) epochs of the regulate condition from the corresponding epochs in the attend condition. As with the other metrics, higher values reflect a greater magnitude of emotion downregulation (i.e. regulation ability).

The relationship between emotion regulation ability and empathy was examined using bivariate correlations, which tested the relationship between measures of cognitive/affective empathy and the self-report and EMG metrics from the regulation task. In addition to trait empathy, the relationship between these emotion regulation metrics and key metrics from the director task and SFM task were examined (see section 3.2.2 for further details of these tasks/metrics).

The normality of each variable was assessed using Kolmogorov Smirnov tests. Spearman's rho is reported for any correlations where at least one variable distribution was significantly non-normal. All tests are reported as two-tailed with a significance threshold of $p = .05$. To ensure that the observed results were not unduly influenced by a small number of outlier cases, the same analyses reported in this results section were conducted following the removal of univariate and bivariate outlier cases (see appendix H). Furthermore, the relationship between the task metrics and a trait measure of emotion regulation (the DERS) was examined (see appendix H).

6.3. Results

6.3.1. Block 1: Emotional reactivity and spontaneous recovery

Self-report ratings

A paired samples t-test demonstrated that arousal ratings were significantly higher for negative (M ± SD = 5.47 ± 1.46), relative to neutral (M ± SD = 2.53 ± 1.29) images, $t(45) = 17.30$, $p < .001$ (fig. 6.2, left panel). Similarly, valence ratings were lower (i.e. more negative) for negative (M ± SD = 2.98 ± 0.85) relative to neutral (M ± SD = 5.37 ± 0.55) images, $t(45) = -14.94$, $p < .001$ (fig. 6.2, right panel).

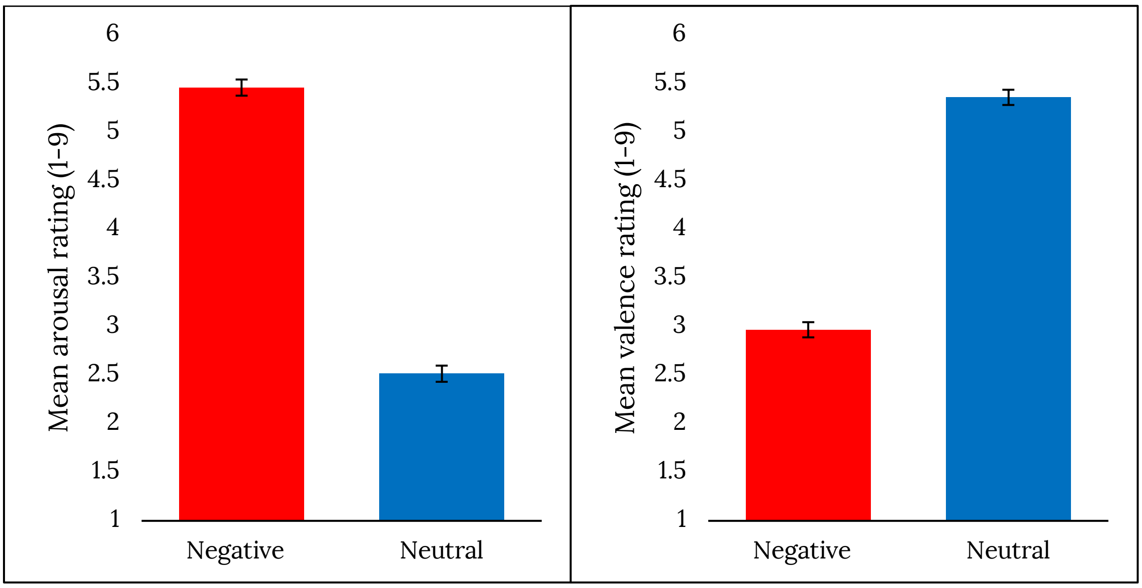

Fig. 6.2. Mean ratings of arousal (left panel) and valence (right panel) for negative and neutral images in block 1. Error bars depict ±1 within-subjects SEM.

Corrugator activity

A repeated measures ANOVA with valence (negative/neutral) and epoch (baseline/reactivity/ recovery) on the dependent variable corrugator activity, demonstrated a significant main effect of valence, $F(1, 45) = 14.96$, p

$< .001$, partial $\eta^2 = .25$, a significant main effect of epoch, $F(1.33, 59.74) = 15.52$, $p < .001$, partial $\eta^2 = .26$, and a significant valence by epoch interaction, $F(1.32, 59.43) = 15.89$, $p < .001$, partial $\eta^2 = .26$.

Pairwise comparisons with Bonferroni adjustment revealed that mean corrugator activity was greater overall for negative compared to neutral images ($p < .001$). Overall corrugator activity was lower within the baseline fixation period relative to the reactivity and recovery epochs (both $p < .001$). There was no difference between corrugator activity for negative and neutral image trials in the baseline period ($p = .90$), however negative images were associated with significantly higher corrugator activity relative to neutral images in the reactivity and recovery epochs (both $p < .001$).

For negative images, corrugator activity was higher in the reactivity and recovery epochs relative to the pre-stimulus baseline (all $p < .001$); corrugator activity for negative images was higher in the reactivity epoch relative to the recovery epoch ($p = .01$). For neutral images, there were no significant differences in corrugator activity across any epochs (all $p >= .67$). Baseline corrected corrugator activity for negative and neutral images across the reactivity and recovery epochs are presented in figure 6.3. For illustrative purposes the mean baseline corrected corrugator activity for each 1 second epoch following image onset are presented in figure 6.4.

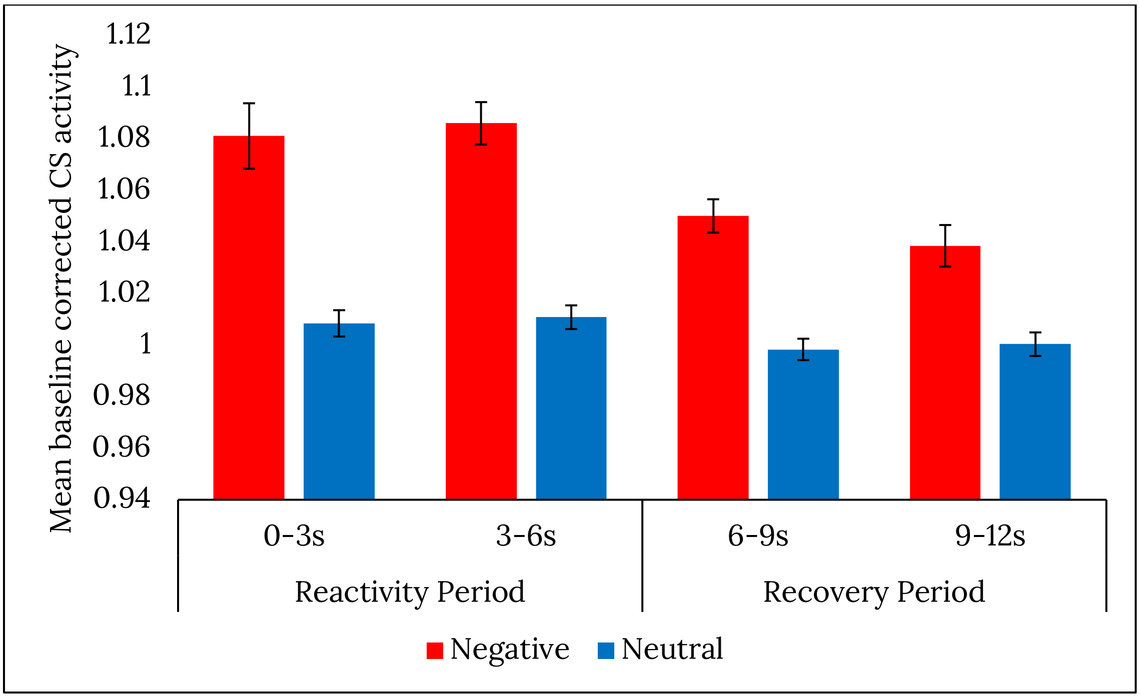

Fig. 6.3. Baseline corrected corrugator activity for negative (red) and neutral (blue) images in the reactivity and recovery epochs. Error bars depict ±1 within-subjects SEM.

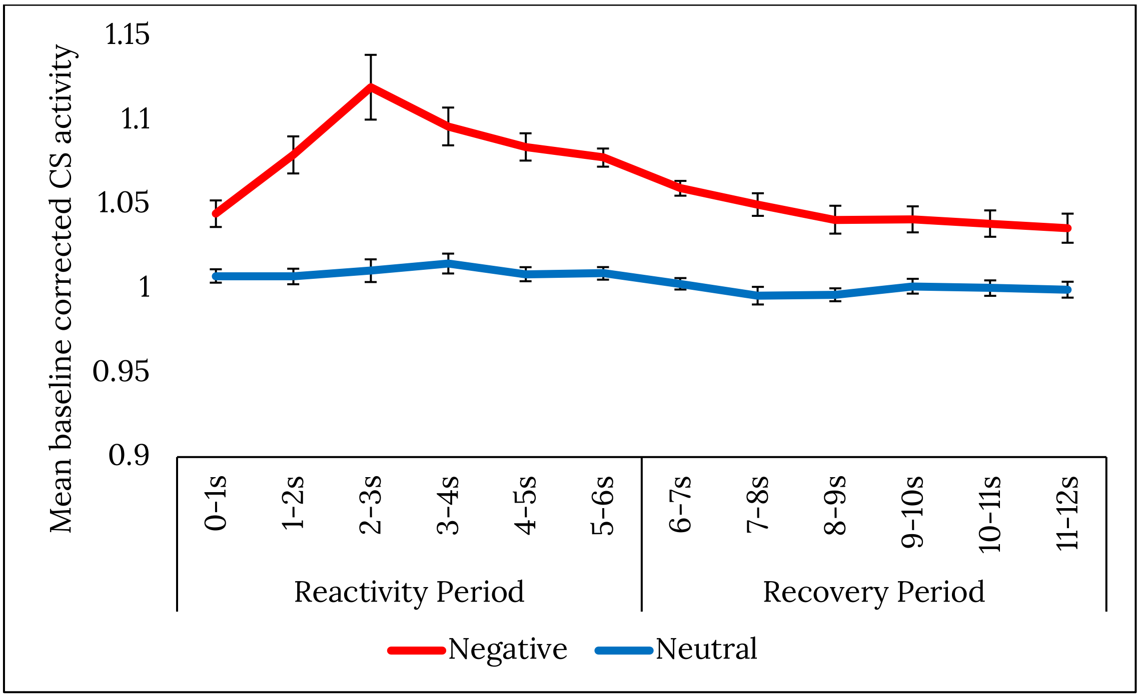

Fig. 6.4. Baseline corrected corrugator activity for negative (red) and neutral (blue) images in each one second epoch of the reactivity and recovery periods. Error bars depict ±1 within-subjects SEM.

Emotional reactivity/spontaneous recovery and empathy

Self-report measures of emotional reactivity

Trait cognitive empathy was not significantly related to arousal ratings for negative images, *rho*(44) = .19, p = .20. Affective empathy also showed no relationship with negative image arousal ratings, *rho*(44) = .10, p = .52. These correlations were not significantly different (Z = 0.67, p = .50). Trait cognitive and affective empathy both showed no relationship with valence ratings for negative images ($r(44)$ = -.03, p = .87; $r(44)$ = .03, p = .86, respectively). These correlations were not significantly different (Z = 0.44, p = .66).

To enable greater clarity regarding the influence of one's propensity and ability in relation to the different dimensions of empathy, the relationship between task-based measures of cognitive/affective empathy and the regulation task self-reported emotional reactivity metrics were examined (table 6.1) (see section 3.2.2 for further details of these tasks/metrics).

Table 6.1.

Correlation results for empathy tasks and self-reported arousal and valence

Variable	Mean arousal rating (neg images)	Mean valence rating (neg images)
Director Task	.05 (p = .75)	-.05 (p = .75)
Angry SFM	.26 (p = .11)	.11 (p = .50)
Happy SFM	.16 (p = .33)	-.11 (p = .50)

Corrugator EMG measures of spontaneous recovery

To examine spontaneous recovery following exposure to negative images, the correlation between each empathy measure and corrugator activity within the recovery epoch (independent of emotional reactivity) was examined. Trait cognitive empathy showed no relationship with the corrugator recovery metric, $r(44) = .14$, $p = .36$. Trait affective empathy showed a non-significant positive trend with the corrugator recovery metric, $r(44) = .23$, $p = .12$. These correlations were not significantly different ($Z = 0.62$, $p = .53$). The correlations between the recovery metric and task measures of cognitive/affective empathy are shown in table 6.2.

Table 6.2.
Correlation results for empathy tasks and spontaneous recovery metric

Variable	EMG spontaneous recovery metric
Director Task	.003 ($p = .99$)
Angry SFM	.17 ($p = .30$)
Happy SFM	.08 ($p = .64$)

6.3.2. Block 2 – instructed emotion regulation

Self-report ratings

A paired samples t-test demonstrated that arousal ratings were significantly higher in the attend (M ± SD = 5.37 ± 1.46) relative to the regulate (M ± SD = 4.45 ± 1.50) condition, $t(45) = 7.54$, $p < .001$ (fig. 6.5, left panel). Similarly, valence ratings were significantly lower (i.e. more negative) in the attend (M ± SD = 2.89 ± 0.68) relative to the regulate (M ± SD = 3.83 ± 0.73) condition, $t(45) = -8.94$, $p < .001$ (fig. 6.5, right panel).

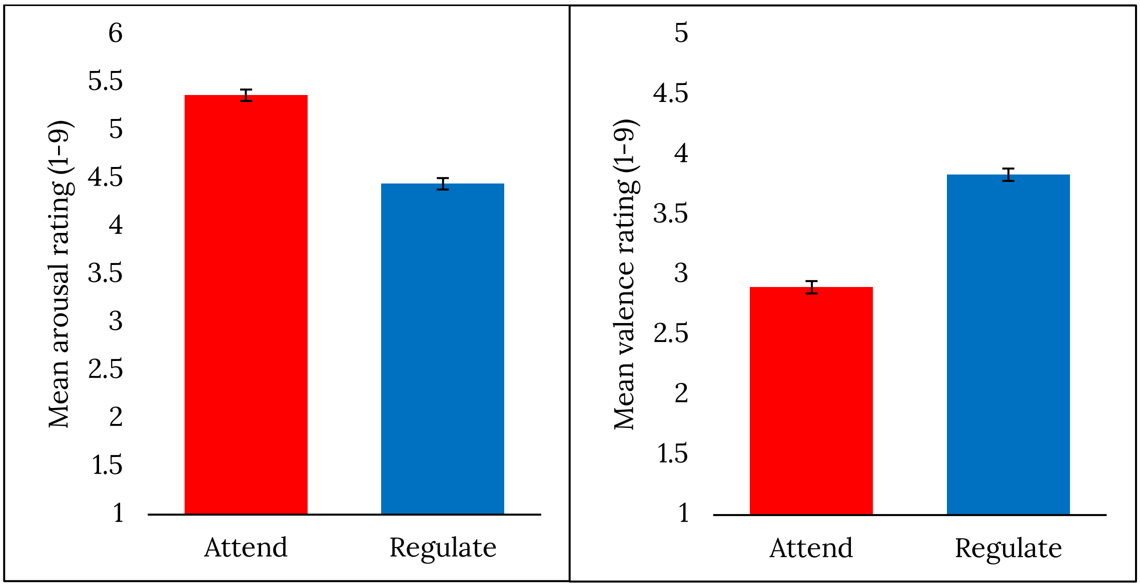

Fig. 6.5. Mean ratings of arousal (left panel) and valence (right panel) for the attend and regulate conditions. Error bars depict ±1 within-subjects SEM.

Corrugator activity

A repeated measures ANOVA with instruction (regulate/attend) and epoch (baseline/reactivity/recovery) on the dependent variable corrugator activity demonstrated a significant main effect of instruction, $F(1, 45) = 7.92$, $p = .007$, partial $\eta^2 = .15$, a significant main effect of epoch, $F(1.45, 65.33) = 15.14$, $p < .001$, partial $\eta^2 = .25$, and a significant instruction by epoch interaction, $F(1.66, 74.65) = 13.31$, $p < .001$, partial $\eta^2 = .25$.

Pairwise comparisons with Bonferroni adjustment revealed that mean corrugator activity was greater in the attend relative to the regulate condition overall ($p = .007$). Corrugator activity in the baseline epoch was significantly lower than in the reactivity ($p < .001$) and recovery ($p = .03$)

epochs. There was no difference between the attend and regulate conditions in the baseline period (p = .65), however, corrugator activity was significantly higher in the attend relative to the regulate condition in the reactivity (p = .003) and recovery (p = .001) epochs.

In the attend condition, mean corrugator activity was lower in the baseline epoch, relative to the reactivity and recovery epochs (both $p < .001$); mean corrugator activity was higher in the reactivity relative to the recovery epoch (p = .007). In the regulate condition, baseline corrugator activity was lower at trend-level than in the reactivity epoch (p = .05), but was not significantly different to the recovery epoch (p = 1.0); corrugator activity was higher in the reactivity epoch relative to the recovery epoch (p = .01).

Baseline corrected corrugator activity for the attend and regulate conditions across the reactivity and recovery periods are presented in figure 6.6. For illustrative purposes the mean baseline corrected corrugator activity in the attend and regulate conditions for each one second epoch of the trial period are presented in figure 6.7.

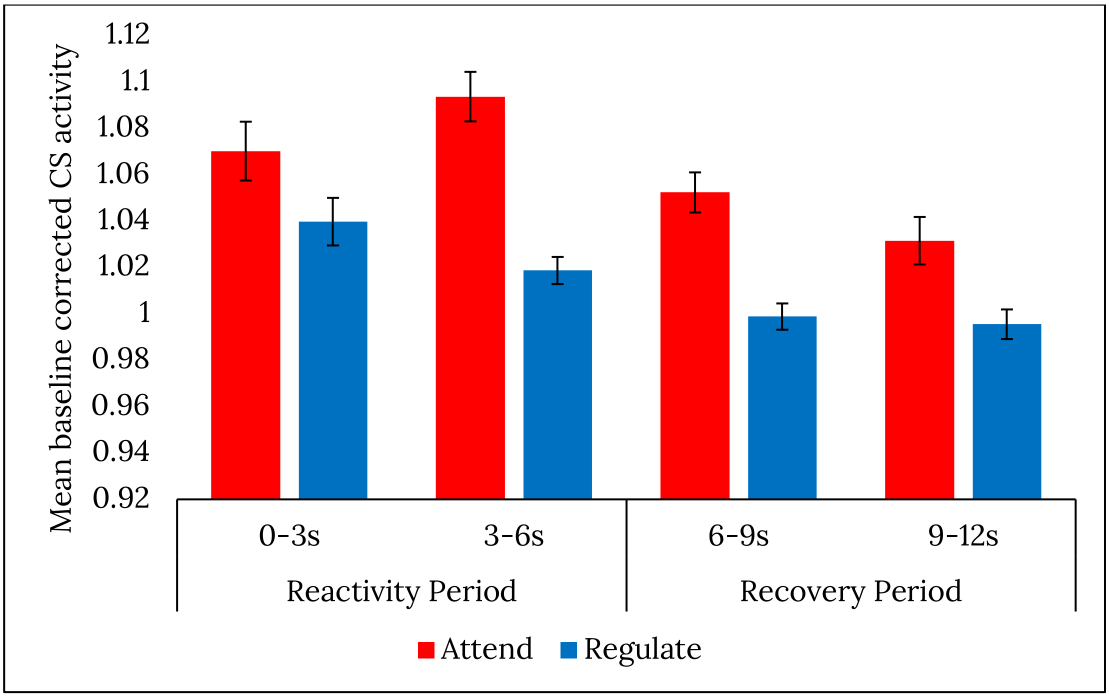

Fig. 6.6. Baseline corrected corrugator activity for negative images in the attend (red) and regulate (blue) images in each reactivity and recovery epoch. Error bars depict ±1 within-subjects SEM.

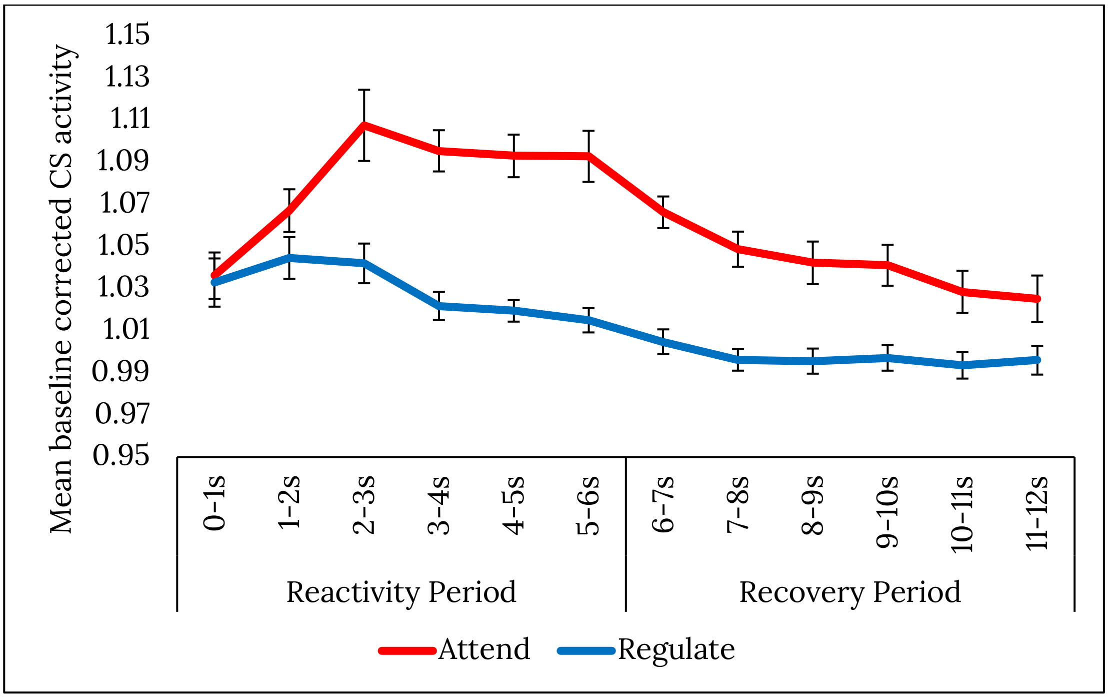

Fig. 6.7. Baseline corrected corrugator activity for negative images in the attend (red) and regulate (blue) in each one second epoch for the reactivity and recovery periods. Error bars depict ±1 within-subjects SEM.

Instructed regulation ability and empathy

Self-report measures of regulation magnitude

To assess instructed regulation ability, the relationship between each empathy measure and the self-reported valence (regulate - attend) and arousal (attend - regulate) regulation metrics were examined. Trait cognitive and affective empathy showed no relationship with the valence regulation metric ($r(44) = .01$, $p = .96$; $r(44) = -.002$, $p = .99$, respectively). These correlations were not significantly different, Z = 0.08, p = .93.

Similarly, there was no evidence of any relationship between cognitive or affective empathy and the arousal rating regulation metric ($rho(44) = -.03$, $p = .85$; $rho(44) = .05$, $p = .73$, respectively). These two correlations were not significantly different, Z = 0.55, $p = .58$. As highlighted in table 6.3, no relationships were observed between self-report metrics of regulation magnitude and task measures of cognitive/affective empathy.

Table 6.3.
Correlations between empathy tasks and self-report regulation metrics

Variable	Mean arousal diff (attend - regulate)	Mean valence diff (regulate - attend)
Director Task	.03 (p = .87)	.16 (p = .35)
Angry SFM	-.001 (p = .99)	.17 (p = .30)
Happy SFM	-.01 (p = .93)	.05 (p = .76)

Corrugator EMG measures of instructed regulation magnitude

Trait cognitive and affective empathy were not significantly related to metrics of regulation magnitude in the reactivity epoch (*rho*(44) = .20, *p* = .18; *rho*(44) = .21, *p* = .17, respectively). These correlations were not significantly different (Z = 0.07, *p* = .94). There was no evidence of any relationship between trait cognitive and affective empathy and the metric of regulation magnitude in the recovery epoch (*rho*(44) = -.08, *p* = .58; *rho*(44) = .11, *p* = .48, respectively). These correlations were not significantly different (Z = 1.32, *p* = .19). There was also no evidence for any relationship between EMG measures of instructed regulation magnitude and task measures of empathy (table 6.4).

Table 6.4.
Correlations between empathy tasks and EMG regulation metrics

Variable	EMG regulation metric (reactivity period)	EMG regulation metric (recovery period)
Director Task	-.08 (*p* = .63)	-.11 (*p* = .50)
Angry SFM	.07 (*p* = .66)	.01 (*p* = .98)
Happy SFM	.08 (*p* = .62)	.01 (*p* = .98)

6.4. Discussion

6.4.1. Summary of findings

This study examined the relationship that cognitive/affective empathy share with self-report and corrugator EMG metrics of (1) spontaneous emotional recovery and (2) instructed emotion regulation ability. In contrast to tasks that instruct participants to use a particular strategy (or strategies) across all regulate trials, this study utilised a paradigm in which participants were free to regulate their emotions using any strategy of their choosing. A benefit of this approach is that it enables a more holistic and ecologically-valid measure of regulation abilities (Baur et al., 2015), which incorporates aspects of strategy selection and implementation (Gross, 2015).

The results suggest that the task was effective in inducing negative affect and that participants were able to downregulate these experiences as instructed; this was evidenced by significant reductions in self-reported negative valence, arousal, and corrugator activity. These findings are aligned with those of various prior studies (Cacioppo et al., 1986, Dimberg, 1990, Jackson et al., 2000; Larsen et al., 2003, Ray et al., 2010; Wu et al., 2012), and one recent study in particular, which utilised a similar "free choice" regulation task (Baur et al., 2015). Additionally, it was observed that some of the self-report and corrugator change metrics from this task showed trend-level relationships with a trait measure of emotion dysregulation that were in the expected direction (see appendix H). Taken together these results suggest that the task was effectively tapping into abilities relevant to emotion regulation.

Across both the spontaneous and instructed blocks, the hypothesised relationship between cognitive empathy and emotion regulation ability was not observed; a trait and task measure of cognitive empathy showed no relationship with self-report and corrugator metrics of emotion regulation ability. While trait affective empathy showed a trend-level positive relationship with a corrugator EMG metric of spontaneous emotional recovery, no significant relationships with the regulation task metrics were observed for a trait and task measure of affective empathy.

6.4.2. Cognitive empathy and emotion regulation

Cognitive empathy showed no relationship with metrics of spontaneous recovery following exposure to negative emotional images. In an instructed regulation block, aside from a weak relationship with a corrugator metric of regulation magnitude that was in the expected direction, there was no evidence to support the hypothesis that cognitive empathy is positively associated with emotion regulation ability.

These findings are in contrast to prior theoretical (Schipper and Peterman, 2013) and empirical work (Lockwood et al., 2014; Powell, 2018; Tully et al., 2016), which suggests that greater cognitive empathy may be associated with improved emotion regulation abilities. Furthermore, these results are discordant with those reported in chapters 2, 3, and 4 of this thesis, which found that cognitive empathy was positively associated with certain emotion regulation abilities. The handful of previous studies that have examined this relationship have typically done so using only trait measures; to my knowledge, this is the first study to examine this relationship using more objective measures of regulation ability that assess different implicit and explicit emotion regulation abilities. Therefore, while the current findings are in contrast to prior work, given the different methodologies used some divergence is not entirely surprising. Similarly, the previous studies in this thesis that reported a relationship between cognitive empathy and emotion regulation assessed different regulatory abilities using different approaches to the current study, which may not necessarily be directly related to one another.

In sum, this study found no strong evidence to support the hypothesis that cognitive empathy is positively associated with emotion regulation ability. Some potential interpretations of these findings in relation to prior theoretical and empirical work are discussed further in section 6.4.4.

6.4.3. Affective empathy and emotion regulation

Given the findings of chapter 5, which suggested that affective empathy was associated with increased downregulation of negative emotion based on implicit but not explicit reappraisal, it was predicted that affective empathy would be positively related to a metric of spontaneous recovery but would show no relationship with metrics of instructed regulation ability. In block 1, trait and task measures of affective empathy showed no relationship with self-report measures of emotional reactivity (i.e. valence and arousal), however a trend-level positive relationship with an EMG measure of spontaneous emotional recovery was observed for trait affective empathy. While not significant, this finding suggests that greater trait affective empathy was associated with a slightly faster recovery (i.e. corrugator return to baseline) following the offset of negative affective images. In block 2, trait affective empathy showed no relationship with self-report or corrugator EMG metrics of instructed regulation ability.

Across previous chapters, affective empathy has shown a mixed relationship with metrics of emotion regulation ability. For example, trait affective empathy was associated with fewer difficulties with emotional awareness and increased magnitude of negative emotion downregulation in an implicit reappraisal task; however, it was also associated with greater self-reported difficulty maintaining goal-focused behaviours and increased emotional interference in an implicit emotion regulation task.

With these results in mind, it is possible that greater affective empathy confers advantages for more implicit and spontaneous regulatory processes but can hinder more explicit and effortful processes. A speculative interpretation might be that any potential benefit that a heightened awareness of one's own emotions may confer on one's emotion regulation abilities, is negated by concurrent heightened levels of emotional interference. This might explain why affective empathy shows some evidence of being associated with improved spontaneous emotional recovery but is largely negatively related or unrelated to metrics assessing more explicit and effortful aspects of emotion regulation.

6.4.4. Summary, conclusions, and limitations

The study reported in this chapter utilised a task measure of emotion regulation that enabled the assessment of different implicit and explicit abilities. In alignment with the extended process model of emotion regulation, performance on this task was reliant not only upon participants' ability to effectively implement regulatory control, but also their ability to select a strategy most suitable for different negative images and the emotional state they evoked (Gross, 2015). Based on self-report (valence and arousal) and EMG (corrugator change) metrics of downregulation magnitude, this study found no strong evidence for any relationship between cognitive or affective empathy and emotion regulation ability.

While the free-choice regulation task provides a more ecologically valid measure of regulation ability than other regulation paradigms, performance on this task may not necessarily provide an accurate reflection on participants' true emotion regulation abilities. While lab-based studies enable greater control over potential confounds, the environment is inherently somewhat artificial and may not accurately capture more naturalistic regulatory behaviours/abilities. One key aspect relevant to real-world emotion regulation that was not assessed by the current task, is the ability to generate appropriate regulatory goals. According to the extended process model of emotion regulation, one need not necessarily regulate all emotions all the time. Instead, the modulation of emotions should only occur when one's current state interferes with the accomplishment of some explicit or implicit goal (Gross, 1998, 2015). A speculative interpretation of the null findings of this study is that any variability in emotion regulation ability may have been overshadowed by differences in the regulation goals of participants with different levels of cognitive/affective empathy.

To explain this point further, I now draw upon some recent theoretical work highlighting the role of goals and motivation in relation to empathy. This work suggests that an individual's level of trait empathy may influence the extent to which they value engaging with the emotions of others. Individuals with higher trait empathy may place greater value upon engaging with another's emotions, even in instances where this might entail experiencing negative emotions (Cameron et al., 2018; Tamir, 2016; Zaki, 2014). In line with this assertion, it is possible that individuals with higher trait empathy were simply more willing to tolerate a higher level of negativity caused by another's emotional state than those with lower trait empathy, which could have overshadowed any potential advantages that greater empathy might entail with regards to regulation ability.

Any such differences in the goal-states participants with different levels of empathy were trying to achieve through regulation might have manifested as differences in the strategies they chose to use during the task. There are various ways in which an individual could regulate the emotions they experience in response to perceiving the negative state of another. For example, one could try to reappraise the state of the other as less negative or simply distract oneself in order not to think about the other's situation (Cameron et al., 2018; Tamir, 2016; Zaki, 2014).

If individuals with greater empathy place more value on engaging with another's emotions, it could be that they were less likely than those with lower levels of empathy to use a strategy that entailed avoiding the other's emotions (e.g. distraction). Perhaps they were instead more likely to use a regulation strategy that entailed still engaging with the other's experience (e.g. reappraisal). Given evidence that distraction is typically more effective than reappraisal in modulating more intense emotional responses in the short-term (McRae, 2016; Sheppes and Levin, 2013; Smoski et al., 2014), this speculative interpretation could explain why the predicted relationship between cognitive empathy and regulation ability was not observed.

While this interpretation may sufficiently explain the observed relationship between trait empathy and regulation ability, it is somewhat less convincing in relation to the results observed for the task measure of cognitive empathy. While trait empathy largely reflects one's dispositional motivation to engage empathic processes, the director task provides a more objective measure of perspective-taking ability (Gehlbach, 2004; Guzman et al., 2016; Santiesteban et al., 2012). Thus, while the relationship (or lack thereof) between trait cognitive empathy and regulation ability may in part be a reflection of different regulation goal-states and patterns of strategy selection, this interpretation is less able to account for the failure to find any significant relationship between emotion regulation metrics and the task measure of perspective-taking ability.

In the context of the speculative interpretation discussed above, one limitation of the current study is that all of the negative images were of a social nature. Given that one would expect greater cognitive and affective empathy to be associated with increased emotional reactivity to others' negative emotions (e.g. Sato et al., 2013; Sonnby-Borgstrom, 2002), it could be that individuals with greater empathy experience greater difficulty in regulating their emotional state in such instances. Thus, it could be that using only social images negated any potential advantage that greater empathy could endow in terms of regulating one's emotions day-to-day, which would often not be triggered by the perception of another individual's emotional state. It would be beneficial for future work to test this speculative interpretation by examining the relationship between measures of empathy and regulation tasks that include both social and non-social stimuli.

Chapter 7

General Discussion

7.1. Summary

Despite increasing theoretical work suggestive of a close relationship between empathy and emotion regulation, there has been relatively little empirical study of how different cognitive and affective component processes associated with empathy relate to different emotion regulation abilities. Building upon a handful of prior studies that have found evidence for a relationship between empathy and emotion regulation using trait measures (Contardi et al., 2016; Lockwood et al., 2014), this thesis utilised a range of methodological approaches to examine the relationship between distinct component processes of empathy and emotion regulation. Based on a series of studies, which used a combination of self-report, behavioural, eye-tracking, and psychophysiology metrics, this thesis found evidence that variability in empathy is associated with individual differences in emotion regulation abilities and behaviours.

In the majority of studies there was some evidence to support the hypothesis that the cognitive and affective dimensions of empathy share different relationships emotion regulation abilities. While there was some evidence to support the prediction that emotion regulation ability would be positively associated with cognitive empathy and negatively associated with affective empathy, some conflicting findings were observed. The results suggest that the nature of the relationship between these constructs varies as a function of: (1) the precise component of emotion regulation and empathy being tested, and (2) the nature of the methods used to assess them. The hypotheses and findings for each study are presented in table 7.1. These findings and their relation to the extant literature are considered in greater detail in subsequent sections.

Table 7.1.
Summary of study hypotheses and findings

Ch	Emp Measure	ER Measure	Hypotheses	Findings
2	Trait (QCAE)	Trait (ERQ) Trait (DERS)	CE positively related to reappraisal use but negatively related to suppression use and emotion dysregulation AE negatively associated with suppression use but positively associated with emotion dysregulation	CE showed positive relationship with reappraisal use and negative relationship with suppression use and emotion dysregulation AE showed negative relationship with suppression use and positive relationship with some facets of emotion dysregulation
3	Task (DT) Task (RMET) Task (SFM)	Trait (ERQ) Trait (DERS)	Perspective-taking ability positively related to reappraisal use; negatively related to suppression use and emotion dysregulation Mental state attribution ability would show no relationship with trait emotion regulation AE negatively associated with suppression use; positively associated with emotion dysregulation	DT metric showed negative correlation with emotion dysregulation and negative relationship with suppression use RMET showed no relationship with any trait emotion regulation measures Angry face SFM positively related to reappraisal use and negatively related to emotion dysregulation

4	Trait (QCAE)	Task (Emo-GNG) Task (Emo-Stroop)	CE associated with reduced emotional interference effects AE associated with increased emotional interference effects	CE associated with reduced emotion interference effects in Emo-Stroop but not Emo-GNG AE associated with increased emotion interference effects in Emo-GNG but not Emo-Stroop
5	Trait (QCAE)	Task (Implicit reappraisal) Task (Explicit reappraisal)	CE positively associated with implicit and explicit reappraisal ability AE no relationship with implicit or explicit reappraisal	CE no relationship with implicit reappraisal; negative relationship with explicit reappraisal AE positively associated with implicit reappraisal; no relationship with explicit reappraisal
6	Trait (QCAE) Task (DT) Task (SFM)	Task (Spont & instructed regulation)	CE positively associated with spontaneous and instructed regulation ability AE positively associated with spontaneous recovery but no relationship with instructed regulation	No relationship between cognitive empathy trait/tasks and regulation task metrics Trait AE showed trend-level positive relationship with recovery; no other relationships observed

7.2. Cognitive empathy and emotion regulation

Based on the literature reviewed in chapter 1, it was predicted that cognitive empathy would be positively associated with emotion regulation ability. Broadly speaking, the results of the studies reported in this thesis provide support for this hypothesis. However, the nature of the relationship between cognitive empathy and emotion regulation varied depending upon the way in which each construct was measured.

7.2.1. Trait and task measures of cognitive empathy and their relationship with trait emotion regulation

In chapter 2, it was observed that higher trait cognitive empathy was associated with more adaptive self-reported strategy use, indexed by a greater propensity to use reappraisal and a reduced propensity to use suppression. Trait cognitive empathy was also negatively related to self-reported emotion dysregulation, which was driven primarily by negative relationships with subscales assessing difficulties with emotional awareness and controlling emotional impulses.

In relative alignment with these results, in chapter 3 it was observed that a task measure of perspective-taking ability (director task; henceforth DT) was negatively associated with trait emotion dysregulation. While this perspective-taking metric showed a negative correlation with suppression use, it was not significantly associated with reappraisal use. In contrast to perspective-taking ability, a task assessing participants' ability to recognise complex mental/emotional states based on images of the eye region (the RMET; Baron-Cohen et al., 1997, 2001) was unrelated to any trait measures of emotion regulation.

These findings provide support for the hypothesis that cognitive empathy is positively associated with emotion regulation ability, and build upon prior work in this area by: (1) showing evidence of this relationship using both trait and task measures of cognitive empathy, and (2) providing greater specificity regarding how different abilities associated with cognitive empathy (i.e. perspective-taking and mental state attribution) are related to trait emotion regulation measures.

While the DT and RMET both assess abilities related to the cognitive component of empathy, these tasks may differ in the extent to which they place demands on effortful cognitive processes (Santiesteban et al., 2012). While there is evidence to suggest that various abilities associated with cognitive empathy are related to the efficiency of domain-general cognitive control processes (Bull et al., 2008; Carlson et al., 2004; Dennis et al., 2009; Goel et al., 1995; Gokcen et al., 2017; Hansen, 2011; Saxe et al., 2004), there may be some variability in the extent to which they each place demands on different sub-processes, such as working memory and inhibition (Bailey and Henry, 2008; Guzman et al., 2015; Spengler et al., 2010).

Santiesteban et al. (2012) assert that a key difference between perspective-taking and mental state attribution/emotion recognition tasks is the extent to which they necessitate the online control of self and other representations. To perform well in the DT, participants must be able to simultaneously hold in mind their own and the director's perspective, and switch between these coactive self and other related representations. These processes are likely to place demands on working memory and inhibitory control, which have also been implicated in various emotion regulation processes (Guzman et al., 2016; Hendricks and Buchanan, 2016; McRae et al. 2010; Messina et al., 2015).

Similar to perspective-taking, reappraisal may require one to simultaneously hold different appraisals in mind and inhibit dominant appraisals in order to generate new and/or sub-dominant appraisals that might serve to modify one's emotional response (Messina et al., 2015). Furthermore, perspective-taking processes are closely related to the emotion regulation strategy sometimes referred to as cognitive distancing (or reappraisal via perspective-taking) (Davis et al., 2011; Kross and Ayduk, 2008; Messina et al., 2015; Webb et al., 2012a). Both of these processes are associated with a shift in perspective and are likely mediated by similar inhibitory control processes, subserved largely by the PFC and temporoparietal junction (TPJ) (Davis et al., 2011; Guzman et al., 2015; Santiesteban et al., 2012).

Given that many forms of emotion regulation are reliant upon similar underlying processes to those associated with perspective-taking (Hendricks and Buchanan, 2016; Kalisch, 2009; McRae et al., 2010; Salas et al., 2014; Saxe et al., 2004; Urry et al., 2009), it could be that individuals with improved perspective-taking abilities are able to engage these processes more efficiently, which facilitates emotion regulation. In contrast, as performance on the RMET is thought to rely upon more automatic processes associated with matching the target expression to expression archetypes and terminology stored in memory (Baron-Cohen et al., 2001; Vellante et al., 2013), a greater capacity for this component of cognitive empathy may confer little advantage in terms of the efficiency of the processes that support emotion regulation.

7.2.2. Trait cognitive empathy and task measures of emotion regulation

In later chapters of this thesis (chapters 4, 5, and 6), I examined the relationship between trait empathy and task measures of different emotion regulation abilities. Reported in chapter 4 were two tasks that assessed implicit emotion regulation abilities associated with controlling impulsive responses in the presence of salient emotional distractors (Emo-GNG and Emo-Stroop). While cognitive empathy showed no relationship with the Emo-GNG task metrics, it was negatively associated with emotional interference effects in an Emo-Stroop task.

Broadly speaking, these results suggest that individuals with greater cognitive empathy were more effective in minimising the interference caused by emotional distractors. These results are consistent with those reported chapter 2, where trait cognitive empathy was negatively associated with self-reported difficulties with impulse control. These findings may also to some extent explain the relationship observed between cognitive empathy and habitual regulation strategy use. Many adaptive forms of emotion regulation, such as reappraisal, are dependent upon cognitive control processes such as working memory and inhibition (Buhle et al., 2014; Hendricks and Buchanan, 2016; Salas et al., 2014). A greater capacity to maintain efficiency of these processes in emotional situations may support the ability to form appropriate regulatory goals and to select and implement more adaptive strategies (Koster et al., 2011; Morillas-Romero et al., 2015; Servaas et al., 2013;). This could explain in part why cognitive empathy was positively associated with the habitual use of reappraisal and negatively associated with the habitual use of suppression.

To test whether the increased use of reappraisal reported by individuals with greater cognitive empathy was also associated with improved reappraisal abilities, chapter 5 examined the relationship between trait empathy and two task measures of reappraisal. No evidence was found to support the hypothesis that cognitive empathy would be positively associated with reappraisal ability. Trait cognitive empathy showed no relationship with the magnitude of emotion downregulation in an implicit reappraisal task. Furthermore, trait cognitive empathy was negatively related to self-report and automated facial coding (AFC) metrics of regulation magnitude in an explicit reappraisal task.

Trait cognitive empathy measures largely reflect one's motivational disposition toward taking others' perspectives (Gehlbach, 2004; Keysers and Gazzola, 2014; Reniers et al., 2011). Accordingly, the results of the explicit reappraisal task could suggest that participants with a greater dispositional propensity to take the perspectives of others were less effective in downregulating negative emotional experiences using reappraisal. Given the social stimuli used in this task, it is possible that an increased disposition to take others' perspectives made it more difficult to adopt a distanced perspective that might facilitate the generation of effective reappraisal narratives. While further work would be required to test this speculative interpretation, it highlights a potentially important divergence between one's ability and propensity for cognitive empathy, and how they relate to emotion regulation.

Taken together, these findings suggest that while cognitive empathy is positively associated with the propensity to use reappraisal, it is not necessarily associated with a heightened ability to downregulate negative emotions using reappraisal. In terms of the extended process model of emotion regulation (Gross, 2015), this could imply that cognitive empathy facilitates the selection, but not the implementation, stage of the regulatory process.

The study reported in chapter 6 utilised a task in which participants were free to choose the means by which they attempted to regulate their emotions. In addition to enabling the assessment of abilities associated with the selection and implementation of emotion regulation strategies, this study also examined the relationship that trait and task measures of empathy shared with a measure of spontaneous emotional recovery. Based on a combination of self-report and corrugator EMG metrics, this study found no evidence for any relationship between trait cognitive empathy and emotion regulation ability. A task measure of perspective-taking ability also showed no relationship with any of the regulation task metrics.

These findings are in contrast to prior chapters, where greater cognitive empathy was associated with more adaptive emotion regulation abilities and behaviours (chapters 2, 3, and 4). Possible explanations for the different relationships that cognitive empathy shows with trait and task measures of emotion regulation are discussed further in subsection 7.4 of this chapter. Here I focus upon the divergent relationships that trait cognitive empathy shows with different emotion regulation tasks.

The finding that trait cognitive empathy was positively associated with implicit emotion regulation abilities (chapter 4) but did not show a similar positive relationship with regulation ability in chapters 5 and 6, could be due to differences in the regulatory processes that these tasks assess. The tasks in chapters 5 and 6 assessed the ability to downregulate negative emotional responses to social IAPS images, whereas the Emo-Stroop assessed more implicit regulatory process that occur at an early stage of stimulus processing. Thus, some divergence between these different task measures should be expected. However, the regulation tasks reported in chapters 5 and 6 were similar in many respects; yet, trait cognitive empathy still showed different relationships with these measures.

These inconsistent findings could be due to variability in the strategies that participants used to regulate their emotions in these tasks. In the explicit reappraisal task (chapter 5), participants were specifically instructed to use only reappraisal, whereas in the chapter 6 regulation task they were free to regulate their emotions using any strategy of their choosing.

In the context of interpreting these results, a pertinent distinction between different regulatory strategies is regarding their relative position along an "approach/avoid" continuum. For example, reappraisal entails a relatively "approach" focused strategy, in which the observer still engages with the emotional stimulus (i.e. the other's situation/emotion in the context of social images), but simply tries to change their appraisals of it. In contrast, attentional deployment and distraction strategies can be considered more "avoidant", in the sense that the individual may attempt to reduce the extent to which they attend the emotional stimulus (Augustine and Hemenover, 2009; Gross, 2015; Rieffe et al., 2014).

People tend to favour more avoidant strategies such as distraction over reappraisal for regulating emotional responses to more intense stimuli (Sheppes et al., 2011; Sheppes and Levin, 2013). There is also evidence to suggest that avoidant strategies like distraction are less cognitively demanding and more effective in inducing short-term emotional modulation than reappraisal (Kanske et al., 2011; Smoski et al., 2014; Strauss et al., 2016). In light of this evidence, it is possible that differences in the strategies that participants used in each of these tasks could to some extent explain the different relationships these measures share with cognitive empathy.

One's capacity to share another's emotion is not driven solely by spontaneous mimicry/embodiment in response to concrete emotion cues. Placing oneself in 'another's shoes' and making inferences about their emotional experience can in itself be sufficient to induce some degree of affective resonance with their imagined state (Bird and Viding, 2014; Goldman, 2011). Given that higher trait cognitive empathy reflects in part a heightened disposition to recognise others' emotions and place oneself in their perspective (Gehlbach, 2004; Keysers and Gazzola, 2014; Reniers et al., 2011), it is reasonable to infer that it might also be associated with increased resonance with others' emotions.

Consequently, the fact that the explicit reappraisal task required participants to maintain engagement with the negative social stimuli may have made regulation more difficult for those with higher trait cognitive empathy. This could perhaps have been due to difficulties in adopting a more detached perspective that might facilitate the generation of alternative reappraisals of the stimuli. In contrast, when participants were free to use any strategy of their choosing, a heightened propensity to take the depicted target's perspective and resonate with their experience may have exerted less of a negative influence, as regulation could be achieved simply by disengaging one's attention from the more evocative aspects of the stimulus (e.g. the other's suffering).

In sum, the findings of these studies provide some evidence to support the hypothesis that greater cognitive empathy is associated with more adaptive emotion regulation. However, the relationship that cognitive empathy showed with emotion regulation abilities demonstrated significant patterns of divergence across these studies.

7.3. Affective empathy and emotion regulation

Based on evidence to suggest that greater affective empathy is associated increased reactivity to social emotional stimuli (Rueckert et al., 2011; Sato et al., 2013; Sonnby-Borgstrom, 2002) it was expected that higher levels of affective empathy would be associated with a heightened sensitivity to the potential emotional interference on cognitive control processes (Hare et al., 2005, 2008; Tottenham et al., 2011). Given the crucial role these processes play in various aspects of emotion regulation (Buhle et al., 2014; Messina et al., 2015), it was predicted that affective empathy would show a negative relationship with metrics of emotion regulation ability. While there was some evidence to support this hypothesis, as was the case with cognitive empathy, the relationship between affective empathy and emotion regulation was different depending upon the way in which each construct was measured.

7.3.1. Trait and task measures of affective empathy and their relationship with trait emotion regulation

Trait affective empathy was not significantly associated with overall levels of self-reported emotion dysregulation, however, it showed significant positive relationships with subscales measuring difficulties (1) managing one's emotions and (2) maintaining goal-focused behaviours in emotional situations. In contrast, trait affective empathy was negatively associated with difficulties with emotional awareness, suggesting that higher affective empathy may facilitate the capacity to reflect upon one's own emotions. Taken together these findings suggest that greater affective empathy may support some aspects of emotion regulation while hindering others.

While affective empathy showed no relationship with the habitual use of reappraisal, it was negatively associated with the propensity to use suppression. This suggests that while greater affective empathy is associated with less frequent use of maladaptive strategies, it is not associated with more frequent use of adaptive reappraisal strategies.

Contrary to the results observed for trait affective empathy, a task measure of SFM (a key component process associated with affective empathy) showed relationships with trait measures of emotion regulation that were broadly indicative of more adaptive emotion regulation abilities. Increased spontaneous mimicry of angry faces was negatively associated with trait emotion dysregulation and showed a positive relationship with the habitual use of reappraisal. Interestingly, no relationship with these emotion regulation measures was observed for mimicry of happy faces (chapter 3).

These results could suggest that emotion dysregulation is associated with valence-specific disruption in spontaneous mimicry mechanisms. It could be that individuals with increased levels of emotion dysregulation exhibit an increased freezing response when exposed to threatening stimuli (e.g. angry faces). It is also possible that these effects were associated with differences in the way in which individuals with high/low trait emotion dysregulation attended to the angry faces. For example, those with greater emotion dysregulation may have been less willing/able to maintain direct eye contact with the threatening angry faces, which could explain their attenuated mimicry response (Hadjikhani et al., 2017).

These findings demonstrate a divergence between trait and task measures of affective empathy in terms of their relationship with emotion regulation. Furthermore, they highlight important considerations regarding the assessment of empathy. Prior work has failed to find evidence of strong convergence between trait and task measures of empathy (Melchers et al., 2015; Murphy and Lilienfeld, 2019), which suggests that these different approaches may not necessarily assess the same underlying constructs. The current findings are broadly consistent with such work and demonstrate that trait and task measures of affective empathy are differentially related to emotion regulation abilities.

7.3.2. Trait affective empathy and task measures of emotion regulation

While trait affective empathy showed no relationship with the self-reported habitual use of reappraisal, it was associated with increased downregulation of negative emotion in an implicit reappraisal task. This suggests that while those with greater affective empathy do not use reappraisal more frequently in their daily lives, they show a heightened capacity for implicit reappraisal through extrinsic contextual information. In contrast, trait affective empathy showed no relationship with reappraisal ability in an explicit reappraisal task and was not significantly related to metrics of spontaneous recovery or regulation ability in an instructed emotion regulation task. In chapter 4, it was observed that trait affective empathy was positively associated with the magnitude of emotional interference effects in an Emo-GNG task.

In attempting to synthesise the findings of these various studies one could speculate that while higher affective empathy is associated with improved trait emotional awareness (chapter 2), which should support emotion regulation, it is also associated with a heightened sensitivity to emotional interference on inhibitory control processes (chapters 2 and 4). This may negate any potential benefit of improved emotional awareness in instances where regulation is more reliant upon effortful cognitive control processes (chapter 5, study 2 and chapter 6, instructed block). However, in instances where emotion regulation is less reliant upon conscious implementation and cognitive control, greater affective empathy may support certain regulation processes (chapter 5, study 1 and chapter 6, spontaneous block).

7.4. Divergent patterns for trait and task measures of emotion regulation in terms of their relationship with cognitive and affective empathy

As noted in the preceding sections, the relationships that cognitive and affective empathy shared with emotion regulation were different depending upon the way in which these constructs were measured. While some of the findings across these studies may at first seem somewhat discordant, there are a number of potential explanations for these divergent results.

At the most basic level, it is important to note that different components of emotion regulation were examined across each of these studies. Therefore, the fact that empathy measures were related to some regulation metrics but not others could simply reflect the fact that cognitive and affective empathy share different relationships with distinct components of emotion regulation. Some studies did assess aspects of emotion regulation that one would expect to be at least moderately related; yet, different relationships with these measures and empathy were still observed. I now highlight some important distinctions between the trait and task measures of emotion regulation used in this thesis and reflect upon their relevance for interpreting the relationships that these measures were found to share with empathy.

7.4.1. Propensity versus ability

While trait cognitive empathy was positively correlated with the habitual use of reappraisal, it showed a negative relationship with the magnitude of emotion downregulation in an explicit reappraisal task. A discrepancy between these reappraisal measures is in many ways not surprising given that one measure indexes an individual's propensity to use reappraisal, whereas the other directly assesses their ability to regulate their emotions using this strategy in a laboratory environment.

While one might assume that more frequent use of a given strategy entails a greater ability to use that strategy, and vice versa, this evidently is not necessarily always the case (Ford et al., 2017). While various prior studies have found evidence of a relationship between the habitual use of reappraisal and task metrics of regulation ability (Brudner et al., 2018; Fitzgerald et al., 2017; Kanske et al., 2012; McRae et al., 2013), in the present studies there was little evidence of convergence between self-reported strategy use and task measures of emotion regulation ability.

Unlike task paradigms, trait measures assess respondents' self-perceptions of their regulatory abilities/experiences, which may not necessarily provide an accurate reflection of their true abilities. For example, many regulatory processes can take place on an implicit level; as such, one may not have the ability to accurately reflect upon certain regulatory abilities (Gyurak et al., 2011; Koole et al., 2015; Mauss et al., 2007). Additionally, individuals may overestimate their own abilities and/or positive traits (John and Robins, 1994), which can leave self-report measures susceptible to certain response biases. This is less true of task measures, particularly those that utilise more objective metrics of emotion, such as fEMG.

7.4.2. Social versus non-social emotional triggers

A further distinction between the trait and task measures used in this thesis is the extent to which they assess regulation of emotional states induced by empathic processes. The trait measures that were used measured participants' typical experiences associated with emotion regulation, which would most likely cover a range of contexts, emotion triggers and states. In contrast, the task measures of emotion regulation in these studies all used social stimuli as a means of inducing emotion.

While one might expect an individual's emotion regulation abilities to show a relatively consistent pattern regardless of how emotion was induced, regulation is a highly contextual phenomenon (English et al., 2017; Gross, 2015; Rottweiler et al., 2018; Suri et al., 2018) and it could be that there are differences in one's ability to regulate emotions as a function of whether they were elicited by social or non-social stimuli.

Consequently, the different relationships that cognitive empathy was found to share with these trait and task measures of emotion regulation could suggest that any potential advantage greater cognitive empathy confers for regulating one's emotions might not apply in instances of negative emotions induced by empathic processes. This could be because a heightened propensity to attend social stimuli and engage empathic processes diminishes the efficiency/efficacy of emotion regulation processes (Hedger et al., 2018; Zaki, 2014). An alternative interpretation is that those with higher trait cognitive empathy place greater relative importance on long-term goals, such as the implicit desire to maintain a positive self-concept of oneself as a compassionate individual, than on short-term goals, such as the desire to reduce one's immediate negative emotional state (Cameron et al., 2018; Zaki, 2014).

7.4.3. Long-term versus short-term emotion regulation processes

Emotion regulation is not simply about one's ability to control emotions in the immediate context, but also how emotions are managed over time (Davidson, 2015; Kuppens et al., 2010). Consider two individuals who experience the same distressing situation. While they may both exhibit similar emotional responses and regulatory efficacy while the situation is occurring, one may subsequently recover from this experience within a few minutes or hours while the other may be plagued by worry and rumination for weeks.

An important distinction between the trait and task measures used in the current set of studies relates to their relative focus upon short-term versus long-term aspects of emotion regulation. While task paradigms assess the relatively immediate consequences of one's regulatory abilities, trait measures assess more stable dispositional emotion regulation experiences and behaviours (Gross and John, 2003). With these considerations in mind, one could infer that the divergent patterns that cognitive empathy showed with trait and task measures of emotion regulation suggest that while greater cognitive empathy does not confer any significant advantage for regulatory abilities based on short-term measures, it may support regulatory process that unfold over a longer time course.

For example, perspective-taking abilities could support the capacity to adopt a distanced self-perspective when reflecting upon past emotional triggers/experiences, which could facilitate self-reflection and positive reappraisals. Indeed, Kross and colleagues (2005, 2008) have shown how recalling past emotional experiences from a distanced perspective vs a more immersed perspective can aid reappraisal and facilitate insight and closure. Thus, it may be that cognitive empathic abilities such as perspective-taking relate to emotion regulation processes that evolve over a longer time course than those examined in lab-based tasks. This might explain why cognitive empathy was consistently associated with more adaptive emotion regulation when assessed by trait measures (which may tap into more long-term aspects of emotion regulation) but showed an inconsistent relationship with more short-term task metrics of emotion regulation ability.

A further mechanism through which cognitive empathy could support adaptive emotion regulation in the long-, but not the short-term, is through implementation intentions. Implementation intention refers to an 'if-then' plan that seeks to build an association between a given cue (e.g. an emotional trigger or state) and a specific regulatory response (Gallo et al., 2009). There is evidence to suggest that the formation of implementation intentions can improve the efficacy of regulation efforts in situ, presumably because the primed association between a given situation and a regulatory action improves the efficiency with which that regulatory response is implemented (Azbel-Jackson et al., 2015; Hallam et al., 2015; Webb et al., 2012b). Consequently, one who is better able to anticipate and predict different emotional situations and the potential outcomes of different regulatory strategies may be more effective in regulating their emotions if/when that situation is encountered.

While to my knowledge there is no direct evidence to suggest that cognitive empathy may support the formation and application of implementation intentions, there is strong evidence from which one might reasonably infer a relationship. In addition to supporting the ability to place oneself in another's perspective, cognitive empathic processes may mediate the ability to shift from one's immediate experience to different temporal/mental locations, such as the perspective of a future or past self (Buckner and Carroll, 2007; Spreng et al., 2009; Suddendorf and Corballis, 2007). Functional MRI studies have demonstrated reductions in vmPFC activity when placing oneself in the perspective of another (Ochsner et al., 2004b), with similar reductions also associated with taking the perspective of a future self (Mitchell et al., 2011, see also O'Connell et al., 2015).

In light of such considerations, it is possible that the relationship between cognitive empathy and emotion regulation is underpinned not by improvements in the implementation of regulatory processes per se, but by a greater ability/propensity to project oneself into potential emotional situations. This form of mental self-projection could trigger the formation of implementation intentions, thereby facilitating the selection and implementation of an appropriate regulation strategy if/when the situation is encountered. Such an interpretation could explain why greater cognitive empathy was consistently associated with more adaptive trait emotion regulation, but the same relationships were not observed for task measures that assessed more short-term consequences of emotion regulation.

7.5. Implications, limitations, and further work

Despite evidence to suggest a close relationship between empathy and emotion regulation, to date very few studies have directly examined this relationship. Furthermore, those that have typically used only trait measures of both constructs (e.g. Lockwood et al., 2014; Powell, 2018; Tully et al., 2016). To my knowledge, this thesis reflects the first research to examine the relationship between empathy and emotion regulation using task-based measures of cognitive and affective empathy, implicit emotion regulation, reappraisal ability, spontaneous emotional recovery, and instructed regulation. Through a systematic examination of the relationship that cognitive and affective empathy share with different abilities related to emotion regulation, the findings of this thesis give greater specificity to the relationship between these constructs.

The current findings provide support for the proposed delineation between the cognitive and affective dimensions of empathy (e.g. Decety, 2010; Goldman, 2011; Shamy-Tsoory, 2009) by demonstrating that they share different relationships with various aspects of emotion regulation. Broadly speaking, they suggest that cognitive empathy is positively associated with some emotion regulation abilities but not with others. The results regarding affective empathy were also mixed, showing a negative relationship with some measures, but a positive relationship with others. The findings demonstrate relationships between various different components of empathy and emotion regulation. Furthermore, they highlight some interesting patterns of divergence in this relationship, which seemed to depend upon the way in which each construct was measured.

These findings make a significant contribution to our understanding of the relationship between these constructs in normative populations and may provide useful insight for better understanding the shared deficits in empathy and emotion regulation observed in certain psychopathologies, such as ASC and borderline personality disorder.

It is important to note that the findings of these studies should be interpreted with certain limitations in mind. Firstly, given the correlational design of each study it is not possible to make any causal claims regarding the observed relationships. The aim of this thesis was to provide a broad examination of some of the processes that comprise empathy and emotion regulation in order to highlight the potential relationships most worthy of further examination by future work. As such, the correlational design of these studies is not an issue per se, but simply a factor that should be considered in assessing the strengths and limitations of this thesis.

A range of empathy and emotion regulation measures were used throughout this thesis. However, given the complex multidimensional nature of these constructs and the myriad processes they each comprise, it would be useful for future work to further examine this relationship using measures that tap into different abilities to the ones used in this thesis.

Additionally, while various metrics were used to assess empathy and emotion regulation, including self-report, behavioural, eye-gaze tracking, and psychophysiology, it would be useful for future work to utilise additional measures. For example, fMRI may be useful to examine whether individual differences in empathy are associated with variability in patterns of brain activation during emotion regulation.

A further limitation is that the sample in most of these studies consisted largely of female university students aged between 18-30. While this is common in psychological research, it does to some extent limit the generalisability of the current set of results. Power analyses for these studies suggested that each sample demonstrated at the least sufficient power to detect effects of a moderate to large magnitude; however, it is possible that some studies may have lacked the power to detect significant relationships of a smaller magnitude. In these instances, however, the data were largely not suggestive of any relationship. As such, it is unlikely that the failure to find significant relationships between empathy and emotion regulation in these studies was due to a lack of statistical power.

Nevertheless, it would be beneficial for future work to examine these relationships in larger and more heterogeneous samples in order to test the generalisability of these results. It may be particularly useful to study the relationship between empathy and emotion regulation in individuals with ASC and borderline personality disorder, where difficulties with both constructs are common (Daros et al., 2018; Frith and Happe, 2005; Roepke et al., 2013; Samson et al., 2012).

It should be highlighted that the emotion regulation measures used in this thesis focus almost exclusively upon the downregulation of negative emotions. While negative states are arguably the most likely to be subject to regulation (Gross, 2015; Tice and Bratslavsky 2000), there are many real-world instances in which one might need to downregulate positive emotions (e.g. attempting to hide one’s amusement in a situation where its expression would be inappropriate). Additionally, the ability to maintain or upregulate both positive and negative states is an important aspect of emotion regulation (Carstensen et al., 2000; Gross, 2015; Gross et al., 2006; Larsen, 2000).

All of the tasks reported in this thesis used social stimuli to induce emotion; thus, one should bear in mind that these findings relate only to emotion regulation abilities in the context of emotion induced through empathic processes. While one might reasonably assume that an individual's emotion regulation abilities would be relatively consistent across emotions induced by social and non-social stimuli, emotion regulation has been shown to be highly context-dependent (Aldao, 2013; Aldao and Nolen-Hoeksema 2012; Suri et al., 2018). It would be beneficial for future work to examine how empathy is associated with emotion regulation abilities using a combination of social and non-social stimuli.

Effort was made to make each task as relevant to real-world emotion regulation as possible, however, the inherently artificial setting and procedure of lab-based tasks mean they may not provide a wholly accurate reflection of participants' real-world emotion regulation abilities (Opitz et al., 2015). It would be beneficial for future work to build upon the present findings by examining how empathy relates to more ecologically valid measures of emotion regulation. In light of the speculative interpretation regarding potential differences in the relationship that components of empathy share with short- and long-term measures of emotion regulation, longitudinal studies and the use of ecological momentary assessment may prove especially informative (Kuppens et al. 2010; Moberly and Watkins 2010).

Even in light of the above limitations, given the paucity of empirical work on this topic, these studies make a significant contribution to current knowledge and represent an important step toward elucidating the nature of the relationship between empathy and emotion regulation. The findings also highlight important considerations regarding the relationship between different methods used to assess empathy and emotion regulation and prompt a number of actionable research questions that future work should seek to address.

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APPENDIX A: QCAE (Reniers et al., 2011)

1. I sometimes find it difficult to see things from the "other guy's" point of view.

2. I am usually objective when I watch a film or play, and I don't often get completely caught up in it.

3. I try to look at everybody's side of a disagreement before I make a decision.

4. I sometimes try to understand my friends better by imagining how things look from their perspective.

5. When I am upset at someone, I usually try to "put myself in his shoes" for a while.

6. Before criticizing somebody, I try to imagine how I would feel if I was in their place.

7. I often get emotionally involved with my friends' problems.

8. I am inclined to get nervous when others around me seem to be nervous.

9. People I am with have a strong influence on my mood.

10. It affects me very much when one of my friends seems upset.

11. I often get deeply involved with the feelings of a character in a film, play, or novel.

12. I get very upset when I see someone cry.

13. I am happy when I am with a cheerful group and sad when the others are glum.

14. It worries me when others are worrying and panicky.

15. I can easily tell if someone else wants to enter a conversation.

16. I can pick up quickly if someone says one thing but means another.

17. It is hard for me to see why some things upset people so much.

18. I find it easy to put myself in somebody else's shoes.

19. I am good at predicting how someone will feel.

20. I am quick to spot when someone in a group is feeling awkward or uncomfortable.

21. Other people tell me I am good at understanding how they are feeling and what they are thinking.

22. I can easily tell if someone else is interested or bored with what I am saying.

23. Friends talk to me about their problems as they say that I am very understanding.

24. I can sense if I am intruding, even if the other person does not tell me.

25. I can easily work out what another person might want to talk about.

26. I can tell if someone is masking their true emotion.

27. I am good at predicting what someone will do.

28. I can usually appreciate the other person's viewpoint, even if I do not agree with it.

29. I usually stay emotionally detached when watching a film.

30. I always try to consider the other fellow's feelings before I do something.

31. Before I do something I try to consider how my friends will react to it.

Subscales and scoring

Cognitive empathy:

Perspective taking: 15, 16, 19, 20, 21, 22, 24, 25, 26, 27
Online simulation: 1 (r), 3, 4, 5, 6, 18, 28, 30, 31

Affective empathy:

Emotion contagion: 8, 9, 13, 14
Proximal responsivity: 7, 10, 12, 23
Peripheral responsivity: 2 (r), 11, 17 (r), 29 (r)

Each item is responded to using a 4-point Likert scale, where 1 = strongly disagree and 4 = strongly agree. The two cognitive subscales are summed to produce the score on the cognitive empathy scale and the three affective subscales are summed to produce the affective empathy score. Reverse coded items are identified by (r).

APPENDIX B: ERQ (Gross and John, 2003)

1. When I want to feel more positive emotion (such as joy or amusement), I change what I'm thinking about.
2. I keep my emotions to myself.
3. When I want to feel less negative emotion (such as sadness or anger), I change what I'm thinking about.
4. When I am feeling positive emotions, I am careful not to express them.
5. When I'm faced with a stressful situation, I make myself think about it in a way that helps me stay calm.
6. I control my emotions by not expressing them.
7. When I want to feel more positive emotion, I change the way I'm thinking about the situation.
8. I control my emotions by changing the way I think about the situation I'm in.
9. When I am feeling negative emotions, I make sure not to express them.
10. When I want to feel less negative emotion, I change the way I'm thinking about the situation.

Subscales and scoring

Reappraisal: sum of items 1, 3, 5, 7, 8, 10

Suppression: sum of items 2, 4, 6, 9

Each item is rated using a 7-point Likert scale, where 1 = Strongly disagree and 7 = strongly agree.

APPENDIX C: DERS-SF (Kaufman et al., 2016)

1. I pay attention to how I feel.
2. I have no idea how I am feeling.
3. I have difficulty making sense out of my feelings.
4. I care about what I am feeling.
5. I am confused about how I feel.
6. When I'm upset, I acknowledge my emotions.
7. When I'm upset, I become embarrassed for feeling that way.
8. When I'm upset, I have difficulty getting work done.
9. When I'm upset, I become out of control.
10. When I'm upset, I believe that I'll end up feeling very depressed.
11. When I'm upset, I have difficulty focusing on other things.
12. When I'm upset, I feel guilty for feeling that way.
13. When I'm upset, I have difficulty concentrating.
14. When I'm upset, I have difficulty controlling my behaviours.
15. When I'm upset, I believe that there is nothing I can do to make myself feel better.
16. When I'm upset, I become irritated with myself for feeling that way.
17. When I'm upset, I lose control over my behaviours.
18. When I'm upset, it takes me a long time to feel better.

Subscales and scoring

Awareness: 1 (r), 4 (r), 6 (r)
Clarity: 2, 3, 5
Impulse: 9, 14, 17
Goals: 8, 11, 13
Non-Acceptance: 7, 12, 16
Strategies: 10, 15, 18

Each item is rated using a 5-point response scale ranging from almost never (0-10%) to almost always (91-100%). Items on each subscale are summed, and the sum of each subscale reflects the DERS-Total score.

APPENDIX D: Chapter 2 supplementary material

D.1. Correlation analysis following outlier removal

Reported here are the results from the chapter 2 trait analysis following outlier removal. Univariate and bivariate outliers were identified using a criterion of 3*IQR and Cook's distance > 4/N (Bollen & Jackson, 1990), respectively (number of outlier cases removed <= 16). Normality was assessed using Kolmogorov Smirnov tests; Spearman's rho is reported for correlations where any of the variable distributions showed significant deviation from normality.

QCAE-ERQ correlations

Variable	Reappraisal	Suppression
Cognitive Empathy	.22 (p = .001)	-.16 (p = .02)
Affective Empathy	.07 (p = .33)	-.31 (p < .001)

QCAE-DERS correlations

Variable	DERS-Total
Cognitive Empathy	-.19 (p = .03)
Affective Empathy	.09 (p = .32)

APPENDIX E: Chapter 3 supplementary material

E.1. Director task instructions

In this task you will be shown a shelving unit with different objects positioned on some of the shelves. I will be viewing the same shelving unit from the opposite side and will give you verbal instructions to move a particular object to a new location. You will notice that some of the shelves have open backs whereas others are covered at the back, meaning that the objects on those shelves can not be seen from my side. When interpreting my instructions, you should consider which objects I can and can't see from my perspective.

Each trial will start with a fixation cross; please focus on this cross whenever it is present on screen. I will see the shelves just before you and will deliver my instruction, at which point you will see the shelving unit. You should first of all decide which object I am asking you to move and to which shelf location. As soon as you have identified the object and the new location, please click the left mouse button once. The cursor will then appear on the screen and you should click on the object you want to move, this will then be highlighted, and then click on the location you want to move this object to. You will then see the object move and the display will progress to the next fixation screen.

While accuracy is most important for this task, you should still try to perform the task quickly; i.e. click the mouse button as soon as you are confident that you know which object should be moved to which location.

E.2. Director task trial-level instructions

Practice 1 (self-perspective):	Move the big camera one shelf up
Practice 2 (self-perspective):	Move the big ball one shelf up
Practice 3 (self-perspective):	Move the ball over the top camera
Practice 4 (director-perspective):	Move the big camera one shelf up
Practice 5 (director-perspective):	Move the big ball one shelf up
Practice 6 (director-perspective):	Move the ball over the top camera

1. Move the bottom camera over the mouse
2. Move the big heart one shelf down
3. Move the leaf over the small cup
4. Move the big camera over the tape
5. Move the ice cream next to the top battery
6. Move the top cup under the yogurt
7. Move the small heart one shelf down
8. Move the perfume next to the bottom ball
9. Move the bottom camera two shelves up
10. Move the big heart one shelf up
11. Move the perfume next to the top ball
12. Move the big camera next to the ice
13. Move the bottom heart over the camera
14. Move the small triangle to the top corner
15. Move the top battery over the ice cream
16. Move the top camera one shelf down
17. Move the top triangle over the cup
18. Move the yogurt under the small cup
19. Move the small camera over the tape
20. Move the perfume next to the bottom triangle
21. Move the bottom ball under the perfume
22. Move the leaf over the big cup
23. Move the ice cream next to the bottom battery
24. Move the bee under the small ball

25. Move the bottom cup to the top
26. Move the bottom ball two shelves up
27. Move the small camera next to the ice
28. Move the big triangle to the bottom corner
29. Move the top camera over the mouse
30. Move the small triangle two shelves up
31. Move the top heart over the camera
32. Move the yogurt under the big cup
33. Move the big battery under the ball
34. Move the small heart one shelf up
35. Move the perfume over the top triangle
36. Move the small battery under the ball
37. Move the bee over the big ball
38. Move the bottom cup under the yogurt
39. Move the big triangle one shelf down
40. Move the big battery one shelf up
41. Move the top ball under the perfume
42. Move the big heart next to the ball
43. Move the bottom triangle over the cup
44. Move the bottom battery over the ice cream
45. Move the top cup to the bottom
46. Move the small battery one shelf up
47. Move the top ball one shelf down
48. Move the small heart next to the ball

Note: Trial order was reversed for half of the sample.

E.3. RMET instructions

On each trial you will see an image of some eyes. For each set of eyes, choose which word best describes what the person in the picture is thinking or feeling by pressing the corresponding number on the keyboard. You may feel that more than one word is applicable but please choose just one word, the word which you consider to be most suitable.

You should try to do the task as accurately as possible. Before making your choice, please make sure that you have read all 4 words. If you really don't know what a word means you can look it up in the definition handout.

E.4. SFM task instructions

In this task you will be shown brief videos of people making different facial expressions. It will last around 4 minutes and you do not need to respond in any way. However, it is important that you look at and pay attention to the faces for the duration of the task.

E.5. Correlation analysis following outlier removal

Reported here are the results from the chapter 3 correlation analysis examining the relationship between task measures of cognitive/affective empathy and trait emotion regulation (DERS & ERQ). Univariate and bivariate outliers were identified using a criterion of 3*IQR and Cook's distance > 4/N, respectively (number of outlier cases removed <= 9). Normality was assessed using Kolmogorov Smirnov tests; Spearman's rho is reported for correlations where any of the variable distributions showed significant deviation from normality.

Empathy Tasks-DERS/ERQ correlations

Variable	DERS-Total	Reappraisal (ERQ)	Suppression (ERQ)
Director Task	-.51 (p = .001)	.27 (p = .11)	-.38 (p = .02)
RMET	-.11 (p = .52)	.06 (p = .73)	.08 (p = .64)
Angry SFM	-.47 (p = .004)	.48 (p = .003)	-.19 (p = .26)
Happy SFM	-.18 (p = .33)	.20 (p = .27)	-.07 (p = .72)

E.6. Relationship between trait and task measures of empathy

To better understand the different relationships with trait emotion regulation observed for these tasks and those observed for the trait empathy measure in chapter 2, the convergence between these different empathy measures were examined (table 3.3.2). The results highlight some interesting points of divergence between trait and task measures of cognitive/affective empathy, which could have implications for understanding the different relationships with emotion regulation observed across trait and task measures of empathy.

Correlations between trait and task measures of empathy

Variable	Director Task	RMET	Mean SFM
Cognitive empathy (QCAE)	.20 (p = .22)	.05 (p = .78)	.35 (p = .03)
Affective empathy (QCAE)	.39 (p = .01)	.08 (p = .61)	.19 (p = .24)

APPENDIX F: Chapter 4 supplementary material

F.1. Emo-GNG task instructions

On each trial a face displaying an emotional expression will be presented on screen. You must press the '0' key with the index finger of your right hand as fast as you can whenever you see a face displaying a particular emotional expression. Do NOT press the button when you see any other expression. At the start of each block you will be told which expression you should respond to.

Example of block instructions:

Press the '0' key as fast as you can whenever you see a HAPPY face. Do NOT press for any other faces; only the HAPPY faces.

F.2. Emo-Stroop task instructions

On each trial a WORD and a FACE will be presented on screen. You must press a button on the keyboard to state whether the WORD is positively or negatively valenced. Try to ignore the face and respond as quickly as possible to the word.

Press '1' if the WORD is POSITIVE
Press '2' if the WORD is NEGATIVE

Please press the appropriate key using either the index or middle finger of your right hand. Remember to respond to the word as fast as you can without making mistakes.

F.3. *Correlation analysis following outlier removal*

Reported here are the results from the chapter 4 correlation analysis examining the relationship between trait empathy and task measures of implicit emotion regulation (Emo-GNG & Emo-Stroop), with outlier cases removed. Univariate and bivariate outliers were identified using a criterion of 3*IQR and Cook's distance > 4/N, respectively (number of outlier cases removed <= 5). Normality was assessed using Kolmogorov Smirnov tests; Spearman's rho is reported for correlations where any of the variable distributions showed significant deviation from normality.

Correlations between trait and task measures of empathy

Variable	Emo-GNG emotional interference	Emo-Stroop emotional interference	Emo-Stroop emotional facilitation
Cognitive empathy (QCAE)	.08 (p = .49)	-.29 (p = .01)	.17 (p = .14)
Affective empathy (QCAE)	.32 (p = .004)	-.01 (p = .91)	-.07 (p = .56)

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F.4. Relationship between trait and task measures of emotion regulation

Reported here are the correlations between the Emo-GNG and Emo-Stroop task metrics and a trait emotion regulation measure (ERQ).

ERQ-Emo GNG/Emo-Stroop correlations

Variable	Emo-GNG emotional interference	Emo-Stroop emotional interference	Emo-Stroop emotional facilitation
Reappraisal (ERQ)	-.05 (p = .68)	-.16 (p = .15)	.29 (p = .01)
Suppression (ERQ)	-.19 (p = .10)	-.04 (p = .73)	-.12 (p = .30)

Emo GNG-Emo Stroop correlations

Variable	Emo-Stroop emotional interference	Emo-Stroop emotional facilitation
Emo-GNG emotional interference	.02 (p = .88)	.21 (p = .08)

APPENDIX G: Chapter 5 supplementary material

G.1. *Implicit reappraisal task instructions*

BLOCK 1 (freeview):
You will be shown a series of images. After each image you will be asked to rate how pleasant/unpleasant the image made you feel. Please provide accurate and honest ratings based upon your initial reaction to the image.

BLOCK 2 (framed):
In this block, before each image you will see a sentence that provides some context for what is happening in the image. As in the previous block you will be asked to rate how pleasant/unpleasant each image made you feel. Please provide accurate and honest ratings based upon your initial reaction to the image.

G.2. *Implicit reappraisal task stimuli*

Neutral IAPS image numbers and frame sentences from the implicit reappraisal task.

IAPS Number	Descriptive Frame Sentence
2025	She is holding her finger to her mouth
2038	The woman is reading something on her laptop
2102	The man reads the stock report every morning
2280	The boy has brown eyes and short hair
2385	Her hair is covering her face
2393	These workers are checking the settings of a complicated machine
2394	The doctor is checking a patient's measurement
2396	The couple are walking down a flight of stairs holding a cat basket
2441	She has blue eyes and long hair
2480	The man is holding the curtains to look out the window
2491	He is checking his temperature with a thermometer
2500	The man has a large white beard
2515	The woman and children are picking strawberries
2579	The chefs are making dumplings in the market
2580	These men play chess three times a week
2593	This café has outdoor seating
2597	People are queuing to buy tuna at the fish market
2635	The cowboy is cold in the snow holding his coat
2749	The man is smoking a cigar and drinking wine in his house
7550	The man is working on an old engineering program

Negative IAPS image numbers and frame sentences from the implicit reappraisal task.

IAPS Number	Neutralising Frame Sentence	Descriptive Frame Sentence
2205	The man's wife was ill but is fully recovering	The man holds his sick wife's hand
2700	These women are overwhelmed with joy at a wedding	The women are crying in a group
3030	With medical care he will only have a small scar	He will have scarring from the flesh wound
3051	The amount of blood makes it look worse than it is	She has some cuts and bruises on her face
3101	With good medical care, this man's burns will heal well	This man has facial burns which require medical care
3180	This is an actress in a film about domestic abuse	She has been beaten and has a black eye
3300	Thanks to medical care she will recover from her illness	She is receiving medical care in a hospital
3350	Thanks to early care this baby develops into a healthy toddler	While in early care this premature baby is being monitored
3500	The man escapes unharmed	The man is being held at gun-point
6212	This soldier is protecting the child	The soldier is watching the child run
6350	This is an actress in a self-defence training video	The man is holding a knife to the woman's throat
6834	Mother and child are protected by the policemen's actions	The police are arresting a man in front of a mother and child
6838	The child is scared but will come to no harm	The child is crying in front of the car
9041	She is just a little shy	She is hiding her face
9220	The couple can take comfort from one another	The couple are at the graveside
9250	These doctors will save the woman's life	The medics are taking the young woman to medical care
9429	The children are being protected by their mothers	The children and mothers are running down the road
9561	The kitten can be treated by a vet	The kitten has an unhealthy-looking eye
9900	Nobody was seriously injured in this car accident	A large number of firefighters were sent to the scene
9921	The firefighters get this woman to safety just in time	The firefighters are carrying a woman from a burning building

G.3. *Explicit reappraisal task instructions*

You will be shown a series of images. After each image you will be asked to rate: (1) how pleasant/unpleasant you felt in response to the image; (2) how much arousal you felt in response to the image. Please be entirely honest in your ratings.

Prior to each image you will be shown a written instruction to either: (1) WATCH, or (2) RETHINK. When the instruction is “WATCH”, attend to the image and allow any thoughts and feelings to arise as they naturally would. Do not try to change the feelings that arise, and keep your eyes on the picture the entire time it is on screen.

When the instruction is “RETHINK”, try to think about what is happening in the depicted situation in a way that helps you feel less negative. For example, you could try to think that whatever is happening is not as bad as it looks or will soon be resolved. You could also think about the steps that could be taken to change the situation.

Please keep your eyes on the image the entire time it is on the screen and do not think about unrelated things. None of the images you will see are staged and it is important that you treat the depicted situations as real and do not simply think that the images are fake. Try to start thinking differently about the depicted situation as soon as the picture appears on the screen; continue to think differently until it disappears.

Some pictures may not make you feel particularly negative. Nevertheless, we ask that you try to find ways to think differently about the picture so that any negative impression, however slight, would be reduced.

G.4. *Explicit reappraisal task stimuli*

Negative IAPS image numbers from the explicit reappraisal task

IAPS Image Number	Image Set (Neg)
2205	1
2375.1	1
2717	1
2799	1
3051	1
3100	1
3181	1
3300	1
3500	1
9400	1
9910	1
9921	1
2141	2
2700	2
2710	2
3030	2
3101	2
3180	2
3350	2
3550	2
9040	2
9250	2
9425	2
9900	2

Neutral IAPS image numbers from the explicit reappraisal task

IAPS Image Number	Image Set (Neu)
2191	1
2393	1
2394	1
2396	1
2500	1
2635	1
2491	2
2515	2
2579	2
2580	2
2597	2
2749	2

G.5. Correlation analysis following outlier removal

Reported here are the results from the chapter 5 correlation analysis examining the relationship between trait empathy and task measures of implicit and explicit reappraisal. Univariate and bivariate outliers were identified using a criterion of 3*IQR and Cook's distance > 4/N, respectively. Univariate and bivariate outliers were identified using a criterion of 3*IQR and Cook's distance > 4/N, respectively (number of outlier cases removed <= 7). Normality was assessed using Kolmogorov Smirnov tests; Spearman's rho is reported for correlations where any of the variable distributions showed significant deviation from normality.

Implicit reappraisal task-QCAE correlations

Variable	Implicit reappraisal task metric
Cognitive empathy (QCAE)	-.10 (*p* = .38)
Affective empathy (QCAE)	.44 (*p* < .001)

Explicit reappraisal task-QCAE correlations

Variable	Self-report change		Facereader AFC valence change	
	Valence	Arousal	Early epoch	Late epoch
Cognitive empathy (QCAE)	-.18 (*p* = .30)	-.37 (*p* = .02)	-.36 (*p* = .03)	.19 (*p* = .30)
Affective empathy (QCAE)	.38 (*p* = .03)	.22 (*p* = .21)	.20 (*p* = .25)	.20 (*p* = .27)

G.6. *Relationship between trait and task measures of reappraisal*

Reported here are the relationships between the ERQ measure of habitual reappraisal use and key metrics of reappraisal magnitude from the implicit and explicit reappraisal tasks.

Implicit and explicit reappraisal task-ERQ correlations

Variable	Implicit Reappraisal Task	Self-report change		Facereader AFC valence change	
		Valence	Arousal	Early epoch	Late epoch
Reappraisal (ERQ)	-.02 (p = .87)	-.10 (*p* = .56)	-.09 (*p* = .61)	-.11 (*p* = .50)	-.12 (*p* = .46)

APPENDIX H: Chapter 6 supplementary material

H.1. Spontaneous and instructed regulation task instructions

BLOCK 1 instructions:
You will be shown a series of images. Please attend to each image and allow any thoughts and feelings to arise as they naturally would. After each image you will be asked to rate: (1) how pleasant/unpleasant you felt in response to the image; (2) how much arousal you felt in response to the image. Please be entirely honest in your ratings.

BLOCK 2 instructions:
In this next block, each image will be preceded by an instruction to either: (1) ATTEND, or (2) REGULATE. When the instruction is "ATTEND", simply attend to the image as in the previous block and allow any thoughts and feelings to arise as they naturally would.

When the instruction is "REGULATE", try to reduce any emotional response that the image evokes, so that you feel less negative about it. You can do whatever you wish to try to feel less negative, we just ask that you don't close your eyes or look away from the image. Please keep your eyes on the image the entire time it is on the screen.

None of the images you will see are staged and it is important that you treat the depicted situations as real. Some pictures may not make you feel particularly negative. Nevertheless, we ask that you try to find ways to reduce any negative impression, however slight.

H.2. Spontaneous and instructed regulation task stimuli

Negative IAPS image numbers from the regulation task

IAPS Image Number	Image Set
2205	1
2276	1
2717	1
2799	1
3030	1
3181	1
3300	1
3500	1
3530	1
9040	1
9400	1
9428	1
9582	1
9635.1	1
9900	1
2095	2
2700	2
2710	2
2900.1	2
3051	2
3101	2
3180	2
3230	2
3350	2
3550	2
6350	2
9250	2
9425	2
9584	2
9910	2
2055.1	3
2141	3
2375.1	3
2703	3
2716	3
3071	3
3100	3
3280	3
3301	3
6313	3
6550	3
9220	3
9254	3
9903	3
9921	3

Neutral IAPS image numbers from the regulation task

IAPS Image Number
2280
2393
2394
2396
2441
2480
2491
2500
2515
2579
2580
2597
2635
2749
7550

H.3. *Correlation analysis following outlier removal*

Reported here are the results from the chapter 6 correlation analysis testing the relationship between trait/task measures of empathy and task measures of spontaneous recovery and instructed regulation magnitude. Univariate and bivariate outliers were identified using a criterion of 3*IQR and Cook's distance > 4/N, respectively (number of outlier cases removed <= 8). Normality was assessed using Kolmogorov Smirnov tests; Spearman's rho is reported for correlations where any of the variable distributions showed significant deviation from normality.

Emotional reactivity & spontaneous recovery-QCAE correlations

Variable	Self-report ratings		EMG recovery metric
	Valence	Arousal	
Cognitive empathy (QCAE)	.04 (*p* = .82)	.23 (*p* = .15)	.13 (*p* = .39)
Affective empathy (QCAE)	.02 (*p* = .91)	.09 (*p* = .56)	-.15 (*p* = .34)

Emotional reactivity & spontaneous recovery-empathy tasks correlations

Variable	Self-report ratings		EMG recovery metric
	Valence	Arousal	
Director task	-.14 (*p* = .44)	.07 (*p* = .68)	-.20 (*p* = .26)
SFM Angry	.10 (*p* = .57)	.38 (*p* = .02)	.06 (*p* = .74)
SFM Happy	-.03 (*p* = .89)	.19, (*p* = .30)	.14 (*p* = .42)

Instructed regulation metrics-QCAE correlations

Variable	Self-report rating change		Corrugator EMG change	
	Valence	Arousal	Reactivity epoch	Recovery epoch
Cognitive empathy (QCAE)	-.17 (p = .29)	-.15 (p = .34)	-.12 (p = .42)	-.12 (p = .42)
Affective empathy (QCAE)	.002 (p = .99)	.06 (p = .70)	.28 (p = .06)	.17 (p = .27)

Instructed regulation metrics-empathy tasks correlations

Variable	Self-report rating change		Corrugator EMG change	
	Valence	Arousal	Reactivity epoch	Recovery epoch
Director task	.21 (p = .22)	.001 (p = 1.0)	-.11 (p = .53)	-.23 (p = .17)
SFM Angry	.22 (p = .21)	-.002 (p = .99)	.21 (p = .24)	-.09 (p = .61)
SFM Happy	.05 (p = .78)	-.02 (p = .90)	-.04 (p = .84)	-.01 (p = .95)

H.4. Relationship between trait and task measures of emotion regulation

To assess the convergent validity of the block 1 regulation task metrics of reactivity and spontaneous recovery, the relationship between these metrics and the DERS were examined. Reported here are the relationships between the DERS measure of self-reported difficulties in emotion regulation and self-report and corrugator EMG task metrics of emotional reactivity, spontaneous recovery, and instructed regulation magnitude.

Reactivity and spontaneous recovery metrics-DERS correlations

Variable	Self-report ratings		EMG recovery metric
	Valence	Arousal	
DERS-Total	.05 (*p* = .77)	-.05 (*p* = .75)	-.25 (*p* = .09)

Instructed regulation metrics-DERS correlations

Variable	Self-report rating change		Corrugator EMG change	
	Valence	Arousal	Reactivity epoch	Recovery epoch
DERS-Total	-.35 (*p* = .02)	-.26 (*p* = .08)	-.15 (*p* = .33)	.05 (*p* = .74)