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The Neural and Behavioral Basis of Empathy for Positive and Negative Emotions

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of Philosophy in Psychology

by

Sylvia Annette Morelli

2012

ABSTRACT OF THE DISSERTATION

The Neural and Behavioral Basis of

Empathy for Positive and Negative Emotions

by

Sylvia Annette Morelli

Doctor of Philosophy in Psychology

University of California, Los Angeles, 2012

Professor Matthew Lieberman, Chair

Empathy provides a window into another person's mind, creating a shared experience between two individuals. This intimate view of another person's emotional world often makes the empathizer feel more connected to the other person and may motivate the empathizer to respond to the other's emotional needs. While past studies have investigated the underlying psychological and neural mechanisms for this fundamental human experience, researchers have predominantly focused on examining empathy for other's negative emotions (i.e. negative empathy). Therefore, the current studies examined the neural and behavioral basis of empathy for positive emotions (i.e. positive empathy) and negative empathy.

Study 1 examined the relationship between empathy and helping, aggression, social connection, loneliness, and life satisfaction at the trait and daily level. In this two-week diary study, 102 participants completed end-of-day surveys on each of these variables, as well as trait

measures. Both positive empathy and negative empathy (i.e. traditional components of empathy) contributed to prosocial behavior, but showed weak and inconsistent relationships with aggression across levels of analysis. Positive empathy, compared to negative empathy, was the strongest predictor of social functioning and life satisfaction at both trait and daily levels, suggesting that positive empathy is particularly important for enhanced social and personal well-being. While past research has not distinguished between positive and negative empathy, the results of this study demonstrate that positive empathy may be a distinct component of empathy that has important behavioral consequences in everyday life.

Study 2 measured neural responses during positive and negative empathy to help identify neural systems that support different components of empathy – perspective-taking, affective congruence, and prosocial motivation. In addition, we examined if brain regions commonly activated during positive and negative empathy would relate to real-world helping behavior. In this study, 32 participants completed an fMRI session assessing empathic responses to individuals experiencing pain, anxiety, and happiness, as well as completing a two-week daily diary in which they reported on daily helping behavior. The results suggest that empathy may be evoked through two different pathways, the mirror neuron or mentalizing systems, as well as engaging affective regions that are congruent with the target's emotion. Finally, empathy generally activated a neural region associated with prosocial motivation (i.e. septal area), and activity in this region was positively associated with prosocial behavior in the real world.

The dissertation of Sylvia Annette Morelli is approved.

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2012

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INTRODUCTION

Human beings are intensely social creatures driven by a need to connect with and understand others (Baumeister & Leary, 1995). Our ability to empathize allows us to step into others' minds and experience their emotional experiences as if they are our own. This powerful connection often compels us to act prosocially in order to relieve another's distress, provide emotional support, or sustain their happy mood (Batson, 2011; Gable, Gonzaga, & Strachman, 2006; Taylor, 2010). In contrast, a lack of empathy may impair the ability to understand others' emotions (e.g. autism) or lead to a complete disregard for others' feelings (e.g. psychopathy) (Blair, 2005). Thus, understanding the intricacies of empathy will provide insight into a fundamental human experience that shapes our daily social experiences and motivates our behaviors towards others. Behavioral and neuroimaging methods provide excellent tools for exploring the complex dynamics of empathy in daily life and understanding how empathy for different emotional experiences is instantiated in the brain (Berkman & Lieberman, 2011).

This dissertation builds on previous neural and behavioral research by addressing several gaps in the literature. The majority of behavioral research has either measured empathy as a stable trait that differs between individuals or manipulated empathy in an experimental paradigm (Baron-Cohen & Wheelwright, 2004; Batson, 2011; M. H. Davis, 1983a; Mehrabian, 1996). Further, past research typically focuses on how empathy for negative emotions (i.e. negative empathy) impacts social interactions and behaviors. Therefore, Study 1 explores how empathy for positive emotions (i.e. positive empathy) relates to prosocial and antisocial behavior, social functioning, and personal well-being at trait and daily levels of experience. In addition, neuroimaging studies typically focus on empathy for only one emotion (e.g. pain), as well as employing simplistic stimuli devoid of social context (Lamm, Decety, & Singer, 2011). Further,

almost no neural studies have examined how prosocial motivation during empathy relates to helping behavior. Thus, Study 2 examines the neural correlates of empathy for pain, anxiety, and happiness (i.e. multiple emotions); utilizes stimuli that are more complex and socially relevant; and explores whether neural activity during empathy relates to real-world helping behaviors.

To investigate these questions, we recruited 102 (39 male) individuals to participate in a two-part behavioral study (Study 1). For the first part of the study, participants completed traditional trait empathy scales and a novel trait positive empathy scale in the laboratory, as well as surveys on trait helping, aggression, social connection, and loneliness. Immediately following the lab session, participants began a two-week daily experience sampling study. For 14 consecutive nights, participants filled out an online end-of-day questionnaire assessing daily levels of empathy (including positive empathy), helping, aggression, social connection, loneliness, and life satisfaction. A subset of 32 participants (16 male) then participated in an fMRI (functional magnetic resonance imaging) scanning session to measure neural responses while empathizing with others' painful, anxious, and happy experiences (Study 2).

Study 1 – Empathy for Positive Emotions: Examining Empathic Disposition and Daily Experiences

Previous research has established clear links between empathy and prosocial behavior, as well as more tentative associations between empathy and aggression, social functioning, and well-being. However, these studies typically assess negative empathy and do not include any measure of positive empathy. In Study 1, we investigated whether positive empathy is a distinct component of empathy and a valuable predictor of prosocial and antisocial behavior, social connection, loneliness, and life satisfaction. Further, employing both trait and daily level

measures of all these constructs provided real-world information about how positive empathy relates to social behaviors, social functioning and well-being in everyday life. Aggregated measurement of these constructs over time and situation, as well as analysis of how these variables covaried across days allowed us to discern whether the relationships between variables occur both within and between individuals. We predicted that positive empathy would be positively associated with helping, social connection, and life satisfaction and negatively associated with aggression and loneliness at trait and daily levels of analysis. Further, we hypothesized that positive empathy would be distinct from traditional components of empathy and would improve our ability to predict important social experiences and behaviors in everyday life.

Study 2 – The Neural Components of Empathy: Implications for Daily Prosocial Behavior

Study 2 aimed to more clearly delineate the neural basis of the three major components of empathy: perspective-taking, congruent affect with the target, and prosocial motivation to help the target. Comparing empathy for positive and negative experiences (i.e. happiness, pain, anxiety) within the same study allowed us to identify which neural systems supported congruent affect with the target. Based on previous work, we hypothesized that dorsal anterior cingulate cortex, anterior insula, and amygdala might be selectively recruited during empathy for negative emotions, whereas ventral striatum and ventromedial prefrontal cortex might be selectively recruited during empathy for happiness. By varying the amount of mental work required to share the experience of a target, we could examine the differential involvement of the mirror neuron and mentalizing systems. Therefore, we predicted that empathy for pain (i.e. low mental effort) would engage the mirror system, while empathy for anxiety and happiness (i.e. high mental effort) would recruit the mentalizing system. Finally, the design of Study 2 allowed us to identify

whether brain regions commonly activated across target emotions represent prosocial motivation and predict real-world helping behavior.

Summary

The following studies use daily experience sampling and neuroimaging techniques to investigate the neural and behavioral basis of empathy for positive and negative emotions. This set of studies aims to address the following questions: 1) is positive empathy a distinct component of empathy? 2) is positive empathy a valuable predictor of prosocial and antisocial behavior, social functioning, and well-being at trait and daily levels of experience? 3) do emotion-specific neural regions support affective congruence during empathy? 4) what neural systems support the mental work required to share the experience of a target? 5) do neural regions common to a general empathic state relate to real-world helping behavior? By examining these questions, I hope to demonstrate that positive and negative empathy are distinct experiences that powerfully impact our interactions with others, as well as our own well-being.

Study1:

Empathy for positive emotions:

Examining empathic disposition and daily experiences

Abstract

Empathy is thought to increase prosocial behavior, reduce aggression, bolster social connections, and enhance subjective well-being. However, efforts to elucidate the relationship between dispositional empathy and these various constructs have generally produced mixed results. Further, past research has not examined the role of empathy for positive emotions in predicting daily social experiences and behaviors. To date, there have been no daily experience studies in this area, which enables consideration of these relationships across different levels of analysis (trait/trait, trait/daily and daily/daily). In this two-week diary study, participants recorded daily levels of empathy, helping, aggression, social connection, loneliness, and life satisfaction. Trait-level measures of these constructs were also collected. Across levels of analyses, positive empathy (POS) showed consistent and strong positive associations with prosocial behavior, social connection, and life satisfaction and a negative association with loneliness – even after controlling for the effects of traditional empathy subscales. Further, POS, compared to the traditional components of empathy, was the strongest predictor of social functioning and life satisfaction at both trait and daily levels, suggesting that positive empathy is particularly important for enhanced social and personal well-being. However, positive empathy showed a weak and inconsistent relationship with aggression across levels of analysis. While past research has not distinguished between empathy for positive and negative emotions, the results of this study demonstrate that POS may be a distinct component of empathy that is valuable for predicting a variety of social behaviors and experiences.

Empathy for Positive Emotions:

Examining Empathic Disposition and Daily Experiences

Empathy is a complicated, multifaceted phenomenon that is critical to the successful navigation of our complex social world. Although the ability to feel empathy may not be a uniquely human gift (Preston & De Waal, 2002), the capacity to vicariously share in the tragedies and triumphs of our fellow human beings certainly exemplifies the best of human nature. Empathy has been broadly characterized as consisting of the following three features: cognitive understanding of the mental state of the target, a congruent or appropriate affective response to the target's emotion, and a self-other differentiation which enables one to track origins of emotional and cognitive responses (Decety & Jackson, 2004). This definition distinguishes empathy from similar but distinct constructs such as emotion contagion or personal distress.

This multidimensional conceptualization of empathy has been captured by a common and well-validated measure of trait empathy, the Interpersonal Reactivity Index (IRI; (Davis, 1983a). While the IRI includes four subscales, the Perspective-Taking (PT) and Empathic Concern (EC) subscales encompass what we consider to be some of the key components of empathy. The PT subscale measures the tendency to spontaneously adopt the point of view of others, an ability that is critical for a cognitive understanding of the mental state of the target. The EC subscale measures a congruent, emotional response to perceiving another in need -- an "other-oriented" compassion or concern for unfortunate others. However, our definition of empathy does not include the Fantasy (FS) subscale, which measures the tendency to transpose oneself imaginatively into fictional situations, because it does not impact interpersonal functioning and social relationships (Davis, 1983a). In addition, the final IRI subscale, Personal Distress (PD), is

not considered a component of empathy (Batson, Fultz, & Schoenrade, 1987; Batson, O'Quin, Fultz, Vanderplas, & Isen, 1983) because it represents a "self-oriented" reaction to others' emotions (i.e. personal distress and discomfort in response to others' extreme distress). Overall, the IRI provides a useful tool for parsing and measuring the cognitive (i.e. PT) and emotional (i.e. EC) components of empathy, as well as closely related phenomenon (i.e. PD). Importantly, past research suggests that the PT, EC, & PD subscales may differentially predict daily social experiences and behaviors, such as helping, aggression, social functioning, and well-being (Batson, Duncan, Ackerman, Buckley, & Birch, 1981; Davis, 1983a, 1983b)

The Role of Empathy in Social Experiences and Behavior

Social and developmental psychologists have attempted to elucidate the role empathy plays in increasing prosocial behavior, decreasing aggressive behavior, facilitating social connection, and enhancing subjective well-being with varying degrees of success (for a review, see (Davis, 1994). Several meta-analyses aimed at examining the relationships between trait empathy and these constructs have showed weak or inconsistent results (Eisenberg & Miller, 1987; Lovett & Sheffield, 2007; Miller & Eisenberg, 1988). However, some researchers have argued that poor measurement of trait empathy and failure to aggregate across time and situations have caused the magnitude of trait empathy effects to be underestimated (Eisenberg & Miller, 1987; Penner, Dovidio, Piliavin, & Schroeder, 2005). Additionally, a failure to find a stronger relationship between empathy and these behaviors may be partly due to biases resulting from self-report measures that rely on introspection (Nisbett & Wilson, 1977), such as the inability of low-empathy individuals to accurately represent their own shortcomings (Kruger & Dunning, 1999).

One means of addressing these methodological difficulties is to describe the associations

between these constructs using daily experience sampling. Daily experience sampling has several advantages over trait measures, as this method aggregates across time and situations and is also less prone to retrospective bias (Bolger, Davis, & Rafaeli, 2003; Reis & Gable, 2000). Additionally, daily diary measures increase ecological validity, as real daily behavior may differ in important ways from behaviors measured in laboratory studies or collected in global retrospective self-reports.

As the lion's share of research on empathy has focused on its relationship to prosocial behavior, aggression, social connection, and subjective well-being, we review these bodies of literature here. We next outline some unexplored aspects of empathy, followed by the advantages of employing a levels-of-analysis approach to examining the nature of empathy's relationship to these constructs, and concluded with an outline of the methodology employed in this study.

Empathy and Prosocial Behavior. Laboratory-based studies have generally demonstrated a clear relationship between experiencing state empathy and consequent prosocial behavior. In an elegant series of studies, Batson and colleagues demonstrated that the experience of empathic concern is consistently associated with helping (Batson et al., 1989; Batson et al., 1981; Batson et al., 1988; Fultz, Batson, Fortenbach, McCarthy, & Varney, 1986; Toi & Batson, 1982). Furthermore, helping engendered by empathic concern appears to be motivated by an altruistic other-focused desire to relieve the distress of the individual in need (for a review, see (Batson, 1991, 2011). In contrast, the experience of personal distress is associated with helping only when avoiding the needy individual is difficult, which suggests that helping in this circumstance is motivated primarily by a desire for personal distress reduction (Batson, 1991). Unfortunately, it has been more difficult to establish unambiguous links between dispositional empathy and helping behaviors. While some developmental studies have shown that trait-level

empathy is associated with consistency in prosocial behaviors across time (Eisenberg et al., 2002; Eisenberg et al., 1999), in general, self-report of dispositional empathy does not strongly predict prosocial behavior (Batson, 1991; Eisenberg & Miller, 1987)

Empathy and Aggression. Empathy has long been thought to play a role in inhibiting aggression (e.g., (Feshbach, 1978; Feshbach & Feshbach, 1982), but unambiguous support of this theory has been difficult to come by. The relationship between empathy and aggression has been largely investigated in young delinquent populations, which generally show decrements in cognitive perspective taking compared to matched controls, particularly for aggressive youths (Chandler, 1973; Cohen & Strayer, 1996; Deardorff, Finch Jr, Kendall, Lira, & Indrisano, 1975; Hogan, 1969; Jurkovic & Prentice, 1977; Lee & Prentice, 1988). However, this pattern has failed to be consistently replicated among non-delinquent samples (Kurdek, 1978; Rotenberg, 1974). In a large meta-analysis which included a range of ages and both normal and delinquent/forensic samples, Miller and Eisenberg (1988) found only low to moderate negative correlations between affective measures of empathy and aggression. A more recent meta-analysis focusing on the relationship between unmanipulated affective empathy and aggression in children and adolescents found similarly inconsistent results, but generally supported an inverse relationship between affective empathy and aggression (Lovett & Sheffield, 2007). Some studies have found dispositional perspective taking to be associated with lower self-reported hostility and aggression, although this measure was inconsistently related to aggression in an experimental paradigm (Davis, 1994; Richardson, Hammock, Smith, Gardner, & Signo, 1994). In sum, a straightforward relationship between aggression and empathy has not yet emerged. Furthermore, because the majority of this research has examined developmental and delinquent populations, it remains unknown how closely empathy and aggression are related in normal adult samples.

Empathy and Social Functioning. Empathy is usually thought about in terms of its consequences for the target of empathy (e.g., receiving help) or society as a whole (e.g., reducing aggression), rather than for the person experiencing empathy. In some ways, this may obscure the fact that empathy is a deeply interpersonal phenomenon in which targets also react back (Håkansson & Montgomery, 2003). The intertwined nature of empathic experience suggests that individual differences in empathy will resonate through individuals' interpersonal relationships and importantly affect social functioning (Davis, 1994). For example, it is possible that higher levels of empathy might facilitate the creation and maintenance of social relationships. Evidence for this view includes studies that show greater dispositional perspective taking to be associated with positive interpersonal behaviors such as even temperament, positive outlook, and good communication skills (Davis & Oathout, 1987, 1992). Eisenberg and colleagues found that children who exhibited greater empathic concern were more socially competent, higher in attentional control, and lower in nonconstructive coping and anger reactions (Eisenberg & Fabes, 1992, 1995). Similarly, Denham and colleagues found emotional competence to be a critical factor in the development of social competence (Denham et al., 2003). Dispositional perspective taking has also been associated with relationship satisfaction (Franzoi, Davis, & Young, 1985), and several studies have shown that empathy plays a mediating role in forgiveness (Fincham, Paleari, & Regalia, 2002; McCullough, Worthington Jr, & Rachal, 1997).

Conversely, low levels of dispositional empathy have been associated with greater loneliness, as has higher levels of personal distress (Davis, 1983a). Similarly, stronger autistic-spectrum phenotype (which is associated with reduced empathy) has been associated with greater loneliness, fewer friendships, and shorter duration of friendships in a non-clinical sample (Jobe & Williams White, 2007). While this body of work is suggestive of the role empathy may play in

facilitating social connection, a clear relationship between empathy and everyday social functioning has yet to be established.

Empathy and Well-Being. Empathy is also thought to enhance the well-being of the empathizer (Mehrabian, 1996; Shanafelt et al., 2005; Wei, Liao, Ku, & Shaffer, 2011). For example, trait emotional empathy (i.e. Balanced Emotional Empathy Scale, BEES) has been associated with general emotional well-being (Mehrabian, 1996). In addition, trait perspective-taking, a key component of empathy, is positively associated with self-esteem, while trait personal distress (i.e. a lack of empathy) is negatively associated with self-esteem (Davis, 1983a). Further, higher levels of empathy were positively related to subjective well-being (e.g. satisfaction with life) in both college students and a community sample (Wei et al., 2011). Finally, medical residents with higher levels of trait PT and EC also showed higher mental well-being (Shanafelt et al., 2005). While these studies provide some initial evidence that empathy is associated with enhanced well-being, no studies have systematically explored the relationship between different components of empathy and subjective well-being.

An Unexamined Aspect of Empathy: Empathy for Positive Emotions

Although considerable research has examined the role of empathy in social behavior and experiences, trait and experimental manipulations of empathy focus predominantly on empathy for negative emotions (e.g. pain, distress, sadness). For example, canonical measures of trait empathy – such as the IRI, BEES, and Empathy Quotient (EQ; (Baron-Cohen & Wheelwright, 2004) – include very few items that assess empathy for positive emotions (i.e. positive empathy, POS). Even when positive empathy items are included, such as in the BEES, the trait scale does not include subscales that distinguish between empathy for positive emotions and negative emotions. Further, the majority of behavioral studies experimentally manipulate empathy for the

distress or suffering of others (i.e. negative emotions) (Batson, 2011; Batson et al., 1988; Eisenberg et al., 2002; Toi & Batson, 1982). Recent work in social neuroscience also shows a similar bias towards investigating empathy for negative emotions (i.e. negative empathy); a recent meta-analysis found that of 40 neuroimaging studies on empathy, 30 focused on empathy for pain (Fan, Duncan, de Greck, & Northoff, 2011).

In contrast, only a few studies have explored the positive side of empathy. For example, recent neuroimaging studies have found that observing others win money or empathizing with others' happy events actives neural regions associated with the first-hand experience of rewards, suggesting that the empathizer is experiencing vicarious reward (Mobbs et al., 2009; Morelli, Rameson, & Lieberman, under review). A few behavioral studies have examined the role of empathic joy in motivating prosocial behavior (Aronfreed, 1968; Batson et al., 1991; Hoffman, 1975, 1981; Smith, Keating, & Stotland, 1989), but no other behavioral work has explicitly manipulated or examined POS as a separate construct from the traditional components of empathy (e.g. PT and EC). Further, no studies have separately measured positive empathy at the level of traits or daily experiences and behaviors (although (Nezlek, Feist, Wilson, & Plesko, 2001) includes an item related to daily positive empathy).

Because the experience of positive and negative affect served different evolutionary purposes and often lead to distinct behaviors (Fredrickson, 1998), it is plausible that empathy for positive and negative emotions may induce different motivational states and social behaviors. For example, empathizing with and sharing negative affect may orient us to the threats and dangers others face in their physical environment (Lazarus, 1991). This affective resonance may then motivate specific actions that will alleviate another's distress, such as helping others (Batson et al., 1989). In contrast, positive emotions may have signaled safety and satiation and

an opportunity to build resources though social connections (Fredrickson, 1998). Thus, positive empathy may motivate behaviors that sustain and enhance others' positive emotions, creating a strong sense of social connection.

Positive Empathy and Prosocial Behavior. While a substantial body of research has shown clear links between empathic concern (i.e. empathy for other's distress) and helping (for a review, see Batson, 2011), much less research has examined the possibility that positive empathy may be associated with prosocial behavior. As Smith and colleagues (1989) posited, individuals may help others because they anticipate sharing vicariously in the needy person's joy at improvement. While it is controversial whether empathic joy motivates prosocial behavior or is a result of prosocial behavior (Batson et al., 1991; Smith et al., 1989), past studies provide tentative evidence that empathic joy or positive empathy may be associated with prosocial behavior. Therefore, we will attempt to substantiate these findings by examining trait and daily level associations between positive empathy and prosocial behavior.

Positive Empathy and Aggression. We are not aware of any research that has looked at whether positive empathy is associated with aggression. Due to the lack of research on this topic, it is difficult to predict whether and how positive empathy will relate to aggressive behaviors. One possibility it that positive empathy may boost the empathizer's own positive affect and reduce aggressive behaviors by diffusing or "undoing" negative emotions such as anger (Burns et al., 2008; Fredrickson, 1998; Fredrickson & Losada, 2005; Fredrickson, Mancuso, Branigan, & Tugade, 2000). Vicarious positive emotion may also buffer individuals from experiencing negative emotions during conflict and thereby inhibit aggressive behaviors (Tugade & Fredrickson, 2004). In order to test these hypotheses, the current study will investigate the nature and strength of the relationship between positive empathy and aggression.

Positive Empathy and Social Functioning. When people turn to others to share their positive emotions (a process called capitalization), the person with whom the positive event was shared has an opportunity to empathize and augment the discloser's positive emotions (Gable, Reis, Impett, & Asher, 2004). Thus, positive empathy may be especially important for strengthening social ties. In fact, a highly empathic response (i.e. active and constructive) to a discloser's positive event increases satisfaction, intimacy, commitment, trust, liking, closeness, and stability in a relationship (Gable & Reis, 2010; Gable et al., 2004; Reis et al., 2010). With couples, supportive responses to positive events are more closely related to relationship well-being and break-up than supportive responses to negative events (Gable, Gonzaga, & Strachman, 2006). These findings suggest that positive empathy (versus negative empathy) may be more closely associated with feelings of social closeness and intimacy.

Positive Empathy and Well-Being. Positive empathy may also enhance the empathizer's mood by vicariously increasing positive affect, potentially leading to increases in subjective well-being. For example, individuals in a relationship reported increased positive affect on days when their partners disclosed positive events to them, an effect called crossover capitalization (Hicks & Diamond, 2008). One possible mechanism for crossover capitalization is positive empathy, suggesting that positive empathy may boost vicarious positive affect and precipitate the many benefits associated with positive emotion (e.g. enhanced subjective well-being; (Diener, Suh, Lucas, & Smith, 1999). In support of this idea, a daily experience sampling study found that daily empathy covaried positively with daily positive affect (Nezlek et al., 2001). While these findings cannot show a direct causal relationship, it suggests that positive empathy may impact the observer's own positive affect. Thus, while past research suggests a link between one's own positive affect and subjective well-being, no studies have yet examined whether

vicarious positive affect (i.e. positive empathy) is also associated with the subjective well-being of the empathizer.

Levels of Analysis Approach

In this paper, we measured empathy, helping, aggression, social connection, loneliness, and subjective well-being using both self-report trait scales and daily diary measures. By measuring the relationship between empathy and these theoretically related constructs at different levels of analysis, we hoped to gain traction on the real-world operation of these constructs (Reis & Gable, 2000). More specifically, we wanted to explore how the traditional components of empathy (i.e. PT, EC, PD), as well as new aspects of empathy (i.e. POS) related to important social behaviors and experiences.

The trait/trait level of analysis examines the relationship between two presumably stable constructs, such as whether trait positive empathy is associated with trait social connection. This commonly utilized approach has proven fruitful for understanding the operation of individual differences and developing psychological measures. This level of analysis taps into self-concept, but may be more vulnerable to biased responding as it relies on participant introspection to a greater degree than daily experience measures (Bolger et al., 2003; Nisbett & Wilson, 1977).

The trait/daily level of analysis can be used to answer three different kinds of questions. The first is whether a trait scale is actually reflective of how that same construct is evidenced in everyday life. For example, do individuals who score high on a measure of trait perspective-taking also demonstrate high average levels of daily perspective-taking? Inasmuch as paper-and-pencil measures should reflect the phenomenology of real life, the association between trait and an analogous daily measurement constitutes a source of convergent validity of such scales. The second question is whether a daily scale can improve predictions of other daily constructs, over

and above its analogous trait scale. For example, will including mean levels of daily empathic concern, in addition to trait empathic concern, increase our ability to predict levels of helping? The third question concerns the ability of trait scales to predict non-tautological behavior. For example, is trait positive empathy associated with daily satisfaction with life? Investigating the association between theoretically linked trait/daily measures provides theories with an importance source of ecological validity.

The between-subjects daily/daily level of analysis investigates the relationship between different individual difference measures in daily life and therefore has the advantage of measuring real-world behavior. This level also avoids some of the pitfalls of retrospective measures by circumventing some of the inaccuracies and biases that may result from introspection (Bolger et al., 2003). For example, a trait measure of empathic concern probably requires self-reflection ("Am I the kind of person who shows concern for unfortunate others?"), while a daily measure allows for a somewhat more dispassionate recording of daily records ("Did I feel concerned for someone in a bad situation today?").

The within-subjects daily/daily level of analysis investigates the relationship between two daily variables within each subject. This analysis shares the strengths of the between-subjects daily/daily level, but also provides temporal information by revealing how two variables track together across time (e.g., are high positive empathy days marked by low levels of loneliness?). For a summary of these levels of analysis and their respective strengths, see Table 1-1.

The Present Study

In this study, we collected several trait subscales of empathy (i.e. PT, EC, PD, POS), along with trait measures of prosocial tendencies, aggression, social connection, and loneliness. Over the course of a two-week daily diary study, we collected daily measures of empathy

subscales, prosocial behavior, aggression, social connection, loneliness, and life satisfaction. We predicted that PT, EC, and POS would generally be positively associated with helping, social connection, and life satisfaction and negatively associated with aggression and loneliness; however, we predicted that PD would show the opposite pattern. We were particularly interested in determining the strength of these associations and how they differed across levels.

Specifically, we were concerned with determining 1) how trait subscales of empathy related to trait helping, aggression, social connection, and loneliness; 2) how trait subscales of empathy related to mean daily subscales of empathy; 3) how trait subscales of empathy related to mean daily helping, aggression, social connection, loneliness, and life satisfaction; 4) how mean daily empathy subscales related to other mean daily constructs (see above); 5) if mean daily empathy subscales improve the prediction of related daily constructs, above and beyond trait empathy subscales; and 6) how daily empathy subscales covary with related daily constructs across days. At each level of analysis, we also aimed to examine how well traditional components of empathy (i.e. PT, EC, and PD) jointly predicted outcomes, as well as the independent, unique contributions of each IRI subscale predictor. We also investigated whether including POS, a previously unexamined construct, increased our ability to predict related constructs, over and above what was predicted by the traditional components of empathy.

Methods

Participants

Participants were 102 undergraduate students (39 male, mean age = 20.06) recruited from fliers posted around the UCLA campus as well as the UCLA Psychology Department subject pool. The sample was restricted to Caucasian participants to avoid unwanted variance in behavior due to cultural, rather than dispositional individual difference, factors. Participants

were told that the study was designed to investigate emotional experience in everyday life and were paid $60 for completing the study. Informed consent was obtained from all participants.

Procedure

All participants completed trait surveys in an initial session, followed by 14 days of online experience sampling surveys. For the initial laboratory session, participants had the study protocol explained to them and completed a battery of trait-level measures on empathy, prosocial and antisocial behaviors, and social well-being. Participants began the daily experience portion of the study one day after their initial session. The daily surveys paralleled the trait level measures, with the addition of a daily subjective well-being measure. The daily surveys were presented in a fixed order across the 14 days. For 14 evenings in a row, an email was sent to each participant at 5 pm with a link to time-stamped online surveys (i.e. SurveyMonkey). An additional text message or e-mail was sent as a second daily reminder at a time close to when the participant typically went to bed. Participants were instructed to complete the survey immediately before going to bed at night.

Trait Measures for Initial Laboratory Session

Trait Empathy. Because empathy is a multifaceted and complex construct, we administered a commonly employed empathy scale, the Interpersonal Reactivity Index (IRI; (Davis, 1983a), that separately measures key components of empathy: perspective taking (α = .84), empathic concern (α = .85), and personal distress (α = .83). Because the IRI predominantly measures negative empathy, we also administered a new 7-item measure assessing empathy for positive emotions (i.e. positive empathy; α = .82), the Positive Empathy Scale (PES; Appendix A; designed by S.M., L.R., & M.L.).

Trait Prosocial & Antisocial Behavior. Trait-level helping was measured using the Prosocial Tendencies Measure (PTM; (Carlo & Randall, 2002) that taps into six types of helping: public, emotional, dire, anonymous, altruism, and compliant (α = .78). As pilot testing indicated that undergraduates do very little charitable giving, three questions pertaining to monetary donations were removed. We assessed trait aggression using The Aggression Questionnaire (TAQ; (Buss & Perry, 1992). We then summed the subscales for less overt forms of aggression – verbal aggression, anger, and hostility (α = .87) – in order to parallel our daily measure of aggression that did not include physical aggression (due to infrequent endorsement in pilot testing).

Trait Social Well-Being. Trait social connection was measured using the same 3-item questionnaire utilized in the daily measure (see below), rephrased to reflect general feelings (α = .83). Trait loneliness was measured using the UCLA Loneliness Scale (α = .94; (Russell, 1996). A trait level measure of life satisfaction was not included.

Daily Measures for 14 Days of Experience Sampling

Daily Empathy. Paralleling the trait empathy measures, daily empathy was assessed using a 14-item measure that was developed to reflect the three dimensions of the IRI – perspective taking (3-items), empathic concern (3 items), and personal distress (4 items) – and an additional subscale assessing empathy for positive events (4 items). Items from all four subscales were scrambled prior to administration. The daily empathy measures are detailed in Appendix B. All questions on the daily empathy, helping, and aggression scales (see below) were answered using a binary response option (no/yes). A "no" was coded as 0 because the event or experience did *not* occur, while a "yes" was coded as a 1. Scores for each day were computed by creating a mean for each subscale or scale, representing the proportion of items out

of the total number of items that were endorsed each day. Mean daily scores were then calculated by averaging scale scores across the 14 days. Because these measures were a count of experiences, it was not appropriate to calculate alpha coefficients.

Daily Measures of Prosocial & Antisocial Behavior. Two forms of daily helping were measured, with 10 items asking about helping a close friend and 11 additional items asking about helping a stranger/acquaintance (see Appendix C). Items for this scale were selected based on the ratings of 17 pilot judges in an effort to select high-frequency items. Several items were adapted from the Self-Report Altruism Scale (Rushton, Chrisjohn, & Fekken, 1981). No measure of helping family members or romantic partners was included, as we did not wish to restrict the sample to individuals living with their families or in romantic relationships. A 12-item measure of daily aggression was developed by adapting items from the TAQ. Several additional items were developed to capture less overt forms of aggression (i.e. verbal aggression, hostility, and anger). Higher-frequency items were selected for the measure based on the ratings of 17 pilot judges (see Appendix D).

Daily Social and Subjective Well-Being. Daily social connection (daily level: $\alpha = .85$; individual-level: $\alpha = .94$) was measured using a 3-item questionnaire modified from the Need-Threat Scale (Williams, Cheung, & Choi, 2000): "Today, I generally felt connected to others," "Today, I generally felt accepted by others," and a reverse-coded item: "Today, I generally felt distant from others" (Eisenberger, Gable, & Lieberman, 2007). Daily loneliness (daily level: $\alpha = .86$; individual-level: $\alpha = .96$) was measured using a 6-item adapted version of the UCLA loneliness scale, assessing how alone or isolated individuals felt each day (Appendix E). Daily satisfaction with life (daily level: $\alpha = .93$; individual-level: $\alpha = .97$) was measured by directly adapting the 5-item Satisfaction with Life Scale (SWLS; (Diener, Emmons, Larsen, & Griffin,

1985). For all of these daily measures, participants indicated how they felt *"today"* by rating their agreement with each statement, using a 7-point scale from *1 (strongly disagree)* to *7 (strongly agree)*. All responses were recoded to range from 0 to 6, then scores for each day were calculated by averaging all the items for each scale together. Mean daily scores for each scale were computed by averaging across the 14 days for each subject.

Results

Due to incomplete data collection, analyses involving trait social connection and trait loneliness were conducted on 101 participants. All other analyses include the full sample of 102 participants. In the initial lab session, participants took an average of 47.22 minutes (*SD* = 19.21) to complete all trait-level measures. For the daily experience sampling surveys, participants completed an average 13.3 out of 14 days of surveys (*SD* = .84). Participants reported that the daily surveys took an average of 7.46 minutes (*SD* = 3.95) to complete. Results from daily level analyses include only the daily surveys completed on time.

Trait/Trait Level of Analysis

Trait IRI and Related Trait Constructs. The first aim of the trait/trait level of analysis was to measure the strength of the relationship between each IRI component of trait empathy – perspective taking (PT), empathic concern (EC), and personal distress (PD) – and related traits (i.e. helping, aggression, social connection, and loneliness). Using a series of bivariate correlations, we found that trait PT was positively associated only with trait helping (see Table 1-2, top left quadrant). In contrast, trait EC had a significant positive relationship with helping and social connection, and a significant negative relationship with aggression. Finally, trait PD showed no significant associations with related trait constructs.

While the bivariate correlations demonstrated that subscales of the IRI were associated with some of the related traits, these analyses could not determine (1) how much variance could be accounted for by using all three of these subscales together and (2) if each subscale contributed unshared or unique variance when predicting the related traits. To answer these questions, we entered the IRI subscales as simultaneous predictors of helping, aggression, social connection, or loneliness in the first step of separate hierarchical linear regression analyses (see Table 1-3, Step 1). Taken together, the IRI subscales (i.e. PT, EC, & PD) predicted substantial variance in trait helping (i.e. 40%) and smaller, but significant variance in trait aggression (i.e. 7%) and trait loneliness (i.e. 5%). Thus, trait IRI is most strongly related to prosocial behavior.

Trait PT was not a significant predictor for any of the related trait outcomes, suggesting it does not explain any unique variance after controlling for trait EC & PD. In contrast, trait EC showed a significant, positive relationship with trait helping and social connection and a significant, negative relationship with trait aggression and loneliness. Finally, trait PD was negatively associated with trait helping, but positively associated with loneliness (both significant relationships). Overall, trait EC (relative to trait PT and PD) played an important role in predicting trait-level prosocial and antisocial behavior, as well persistent feelings of social connection and isolation.

Trait Positive Empathy and Related Trait Constructs. We also wanted to explore if and how trait positive empathy (POS) related to the other trait constructs. In particular, we hoped to establish that trait POS was positively associated with prosocial behavior and improved social functioning and negatively related to antisocial behavior and social isolation. As predicted, we found that trait POS correlated positively with trait helping and social connection, but correlated negatively with trait aggression and loneliness (see Table 1-2, top left quadrant).

Next, we wanted to investigate whether adding trait POS increased our ability to predict related traits, *over and above* what was predicted by the traditional components of empathy (i.e. PT, EC, & PD). Further, when trait POS did explain unique variance, would it be the *best* predictor of related traits? To examine the role of trait POS in predicting related traits, we added trait POS as an additional predictor in the second step of the hierarchical linear regressions described above (see Table 1-3, Step 2). After accounting for shared variance with trait PT, EC, and PD, trait POS increased the predicted variance for trait helping by 3% (see R-squared change), by 7% for trait social connection, and by 9% for trait loneliness (all significant at $p < .05$). When compared to trait PT, EC, and PD, trait POS was the best predictor of trait social connection and loneliness (i.e. the largest standardized beta coefficients in Step 2) and the second best predictor of trait helping. However, trait POS predicted no additional variance (i.e. 0%) for trait aggression. Overall, including trait POS, in addition to the traditional components of trait empathy, increases our ability to predict traits related to social functioning.

Trait/Analogous Daily Level of Analysis

Trait Empathy and Mean Daily Empathy. The goal of the "analogous" trait/daily level of analysis was to assess the degree to which dispositional empathy functions as an accurate proxy measure for everyday empathic experiences. For this set of analyses, daily measures were averaged across the 14 days of experience sampling to produce mean daily measures. We found moderate correspondence between trait and mean daily PT, as well as trait and mean daily EC (see Table 1-4). However, trait and daily measures of PD showed weaker correspondence. This suggests that, for at least these empathy measures, the dispositional measure is a reasonable, though far from perfect, indicator of everyday experience. In other words, the trait IRI measures capture some, but still a minority, of the variance in mean daily IRI measures. Trait and mean

daily measures of POS showed a solid correspondence (see Table 1-4), suggesting that trait measures of positive empathy may be a reasonable proxy for positive empathy in everyday life. Thus, asking an individual to report how empathic they are in general (i.e. trait empathy) may be similar, but slightly different from asking that individual how much empathy they experienced at the end of each day for several days.

Trait/Related Daily Level of Analysis

Trait IRI and Related Mean Daily Measures. After establishing that trait empathy generally maps onto daily experiences of empathy, we also wanted to examine whether trait empathy predicts relevant real-world behaviors. These analyses focused on whether trait IRI relates to other daily outcomes that might be expected to arise from empathy. Again, daily measures were averaged across the 14 days of experience sampling to create mean daily scores for related constructs. Correlational analyses revealed that trait PT is significantly related to many daily social experiences and behaviors, showing a modest positive relationship with daily friend and stranger helping, social connection, and life satisfaction (see Table 1-2, top right quadrant). Trait PT also showed a modest negative relationship with daily aggression and loneliness. In addition, trait EC correlated positively with daily friend helping and social connection, while trait PD was positively associated with daily aggression and loneliness.

Similar to the trait/trait level of analysis, we again wanted to determine the total amount of variance explained by all three IRI subscales, as well as each subscale's ability to uniquely predict each of the related daily measures. In the first step of the hierarchical linear regression analyses, the IRI subscales jointly predicted significant variance in daily friend helping, aggression, social connection, loneliness, and life satisfaction, ranging from 4 to 11 percent explained variance (see Table 1-5, Step 1, adjusted R-squared). However, only trait PD uniquely

predicted daily social connection and loneliness. None of the three IRI subscales were unique predictors of daily friend helping, stranger helping, aggression, or life satisfaction.

Trait POS and Related Mean Daily Measures. While trait POS was clearly linked to other related traits, we also wanted to determine whether trait POS related to a broad range of daily social experiences and behaviors. Bivariate correlations revealed that trait POS had a modest positive relationship with daily friend and stranger helping, social connection, and life satisfaction, as well as a modest negative relationship with daily loneliness (Table 1-2, top right quadrant).

Next, we examined whether trait POS would explain additional variance in related daily variables (above and beyond trait PT, EC, and PD), as well as whether trait POS would outperform the trait IRI subscales as predictors. To accomplish this, trait POS was entered in the second step of the hierarchical linear regression analyses listed in Table 1-5. Trait POS added a significant amount of unshared variance (i.e. 3-10%) for daily friend helping, stranger helping (marginal at $p = .06$), social connection, loneliness, and life satisfaction. Further, trait POS outperformed all of the trait IRI subscales by contributing the largest amount of unshared variance for all of these same daily constructs (see standardized beta coefficients in Table 1-5, Step 2). However, trait POS added no additional variance for daily aggression. Overall, trait POS made distinct contributions as a predictor of daily social experiences, enhancing our ability to approximate prosocial behaviors, social functioning, and well-being in daily life.

Between-Subjects Daily/Daily Level of Analysis

Descriptive Statistics. Relative to other daily empathy subscales, individuals engaged in perspective taking the most frequently, endorsing at least one or more perspective taking items on 76% of the 1356 days. Averaging across the 14 days, individuals endorsed an average of 1.62

out of 3 perspective taking items per day (*SD* = .84 items). They also reported experiencing positive empathy (one or more items) on 64% of the days and empathic concern (one or more items) on 55% of the days. Averaging across the 14 days, individuals endorsed an average of 1.60 out of 4 positive empathy items (*SD* = 1.08 items) and an average of 1.05 out of 3 empathic concern items per day (*SD* = .72 items). However, individuals reported experiencing personal distress much less frequently, endorsing one or more items on only 25% of the days. Averaging across the 14 days, individuals endorsed an average of 0.36 out of 4 personal distress items per day (*SD* = .36 items).

Overall, individuals reported doing at least one helpful thing for their friends on 87% of the days and at least one helpful thing for a stranger or acquaintance on 85% of the days. Averaging across the 14 days, individuals endorsed an average of 2.9 out of 10 friend helping items (*SD* = 1.40 items) and an average of 2.42 out of 11 stranger helping items per day (*SD* = 1.43 items). On the other hand, individuals reported at least one aggressive act (e.g. getting into an argument) on 72% of the days and endorsed an average of 2.85 out of 15 aggression items per day (*SD* = 1.50 items). In general, individuals felt socially connected, with an average score of 4.75 on a 0-6 scale (*SD* = .81) across 14 days, and did not feel very lonely, with an average of 1.2 on a 0-6 scale (*SD* = .80). Finally, our sample felt somewhat satisfied with their lives scoring an average of 3.84 on a 0-6 scale (*SD* = 1.04) across 14 days.

Between-Subjects Mean Daily IRI and Mean Related Daily Constructs. Because trait empathy measures require introspection about empathic experiences in general, daily surveys of empathy may more accurately capture individual differences in real-world empathic experiences by only asking participants to reflect about what occurred over the past day. Therefore, it is critical to confirm that daily empathy (in addition to trait empathy) predicts daily prosocial and

antisocial behavior, as well as daily social functioning. To quantify individual differences in daily experiences, mean daily scores were created by averaging across the 14 days of experience sampling and then used in bivariate correlation analyses (see Table 1-2, bottom right quadrant). Daily PT significantly correlated with daily friend and stranger helping, social connection, and life satisfaction (all positive relationships). Both daily EC & PD positively related to daily friend and stranger helping, as well as daily aggression.

Next, we conducted several hierarchical linear regression analyses to determine how well daily IRI subscales could jointly predict related daily outcomes (see Table 1-6, Step 1). Taken together, daily IRI subscales predicted significant variance in daily friend and stranger helping (43% and 20% explained variance, respectively), as well as daily aggression (9% explaineed variance). Daily PT was a unique and significant predictor for daily friend and stranger helping, while daily EC was a significant predictor only for friend helping. Daily PD uniquely predicted only daily aggression. Thus, daily IRI subscales only significantly related to daily measures of prosocial and antisocial behavior.

Between-Subjects Mean Daily POS and Mean Related Daily Constructs. Using correlational analyses to explore the relationship of daily POS with related daily constructs, we found that daily POS positively correlated with daily friend and stranger helping, social connection, and life satisfaction, while negatively correlating with daily loneliness (see Table 1-2, bottom right quadrant). We also explored whether daily POS would increase explained variance above and beyond daily PT, EC, and PD, as well as uniquely and significantly predict related daily measures, (see Table 1-6, Step 2). In general, daily POS accounted for significant unshared variance (i.e. 9 – 17%) for all of the related daily outcomes (except daily aggression). Further, daily POS emerged as the strongest predictor for these same 5 related daily constructs

(i.e. daily friend and stranger helping, social connection, loneliness, and life satisfaction). Thus, daily POS is strongly connected to daily social behaviors and social functioning, and increases our ability to predict individual differences in these important daily outcomes beyond what can usually be predicted with daily IRI subscales.

Trait and Daily Empathy As Predictors of Related Daily Constructs

Trait IRI and Daily IRI. In the next set of analyses, we determined whether each daily IRI subscale can enhance the prediction of related daily experiences, above and beyond its analogous trait IRI subscale. Because daily empathy measures were repeatedly administered within subjects (14 days), we hypothesized that the increased stability and accuracy of mean daily empathy measures (compared to equivalent trait measures) would generally improve predictions for related daily outcomes. We used a series of two-step hierarchical linear regression analyses, entering the trait IRI subscale at Step 1 and its analogous daily empathy subscale at Step 2 (see Table 1-7). Overall, daily PT, EC, and PD each predicted additional, unshared variance (above and beyond their analogous trait subscales) for daily friend helping, stranger helping, and aggression. Further, the daily IRI subscales, compared to analogous trait IRI subscales, were almost always the stronger predictor for the related daily outcomes (see standardized beta coefficients in Table 1-7, Step 2). However, these same daily IRI subscales contributed no additional variance beyond their analogous trait IRI subscales when predicting daily social connection, loneliness, or life satisfaction. Overall, these patterns suggest that daily IRI subscales should be used in conjunction with their analogous trait IRI subscales to improve predictions about daily prosocial and antisocial behavior.

Trait POS and Daily POS. Parallel analyses were conducted to determine if daily POS explains additional, unique variance, beyond trait POS, for related daily constructs. After

controlling for trait POS, daily POS added more significant variance for all the related daily outcomes, except for daily aggression (see Table 1-7, Step 2). Supplementing trait POS with daily POS leads to a substantial benefit when predicting daily prosocial behavior (i.e. 19-31% additional variance) and a smaller benefit (i.e. 4-8% additional variance) when predicting daily subjective well-being, social connection, and loneliness. Further, daily POS, compared to trait POS, is the stronger predictor for daily friend helping, stranger helping, and life satisfaction. However, trait POS is the stronger predictor for daily social connection and loneliness. Thus, daily POS should be used in conjunction with trait POS to improve predictions about daily helping and subjective well-being.

Within-Subjects Daily/Daily Level of Analysis

The within-subjects daily/daily level analyses were conducted with hierarchical linear modeling (HLM; (Bryk & Raudenbusch, 1992), which was designed to analyze daily-level data nested within individuals. We aimed to examine if empathy covaries with helping, aggression, social connection, loneliness, and life satisfaction over a 14-day period. If the within-subjects daily/daily level associations replicate associations found at the trait/trait, trait/daily, and between-subjects daily/daily level, this will provide greater confidence that these associations are not due to unmeasured characteristics of the individuals (Telzer & Fuligni, 2009).

Covariance of Daily IRI and Related Daily Constructs. For the first series of HLM models, individuals' daily level of friend helping, stranger helping, aggression, social connection, loneliness, and life satisfaction were each predicted by whether and how much PT, EC, *or* PD they experienced that day. Identical models were estimated for each daily outcome. The statistical models that were estimated for each outcome were as follows:

$$\text{related daily outcome}_{ij} = b_{0j} + b_{1j}\,(\text{perspective taking}) + e_{ij} \qquad (1)$$

$$\text{related daily outcome}_{ij} = b_{0j} + b_{1j}\,(\text{empathic concern}) + e_{ij} \quad (2)$$

$$\text{related daily outcome}_{ij} = b_{0j} + b_{1j}\,(\text{personal distress}) + e_{ij} \quad (3)$$

For example, the related daily outcome on a particular day (i) for a particular individual (j) was modeled as a function of the average daily outcome of the individual across days (b_{0j}) and their perspective taking (b_{1j}).

On days when individuals experienced more PT, they helped friends and strangers more, felt more socially connected and satisfied with their life, and felt less lonely (see Table 1-8). However, counter to our predictions, PT covaried positively with aggression, perhaps because some PT items (e.g. "Today, I could appreciate someone else's opinion even though I disagreed with it") were so similar to aggression items (e.g. "I told someone that I disagreed with them"). EC mirrored the patterns for PT, but showed weaker associations with social connection and loneliness and no association with life satisfaction. PD positively covaried with both prosocial (i.e. friend helping) and antisocial behavior (i.e. aggression). Overall, PT was reliably linked to all the related daily outcomes, highlighting how central this construct is for understanding daily social experiences and behaviors. While EC and PD still had significant relationships with some of the related daily outcomes, these relationships were restricted to a smaller number of outcomes and were often weaker associations.

Covariance of Daily POS and Related Daily Constructs. The next series of HLM models investigated whether the amount of positive empathy an individual experienced on one day could predict their degree of friend helping, stranger helping, aggression, social connection, loneliness, and life satisfaction on the same day, across 14 days. The statistical models that were estimated for each outcome were as follows:

$$\text{related daily outcome}_{ij} = b_{0j} + b_{1j}\,(\text{positive empathy}) + e_{ij} \quad (4)$$

On days individuals experienced more positive empathy, they also helped friends and strangers more, felt more socially connected and satisfied with their life, and felt less lonely and aggressive (see Table 1-8).

Covariance of All Daily Empathy Scales and Related Daily Constructs. For the next series of HLM models, individuals' daily levels of friend helping, stranger helping, aggression, social connection, loneliness, and life satisfaction were each predicted by whether and how much PT, EC, PD, *and* POS they experienced that day. In other words, all components of daily empathy were entered as simultaneous predictors. Identical models were estimated for each daily outcome. The statistical model that was estimated for each outcome was as follows:

$$\text{related daily outcome}_{ij} = b_{0j} + b_{1j}\,(\text{perspective taking}) + b_{2j}\,(\text{empathic concern}) + b_{3j}\,(\text{personal distress}) + b_{4j}\,(\text{positive empathy}) + e_{ij} \qquad (5)$$

The related daily outcome on a particular day (i) for a particular individual (j) was modeled as a function of the average daily outcome of the individual across days (b_{0j}) and their PT(b_{1j}), EC (b_{2j}), PD (b_{3j}), and POS (b_{4j}).

By entering all of the empathy subscales as simultaneous predictors, we could examine whether each predictor remained significant, after controlling for the effects of the other empathy subscales on the same day. While HLM analyses only produce unstandardized beta coefficients for each predictor, we can still examine the relative contributions of each subscale because the subscales used the same unit of measurement (i.e. number of items endorsed out of total number of items in subscale). Daily PT remained a significant predictor for all the related daily outcomes, except for life satisfaction. Daily EC only uniquely predicted daily friend and stranger helping. Daily PD emerged as a significant and unique predictor for 5 out of the 6 related daily outcomes, showing positive associations with aggression and loneliness and

negative associations with social connection and life satisfaction. Finally, daily POS was significantly associated with all of the daily related outcomes. More specifically, daily POS was linked with increased prosocial behavior, social connection, and subjective well-being; conversely, it was associated with less aggression and loneliness. Further, compared to the other empathy subscales, daily POS had the strongest relationship with daily social connection, loneliness, and life satisfaction. Overall, daily PT, PD, and POS each play important and distinct roles in within-subject daily level associations with prosocial and antisocial behavior, social functioning, and well-being.

Discussion

The present study utilized both trait self-report questionnaires as well as daily diary methods in a novel approach to investigating the relationship between empathy and prosocial behavior, aggression, social functioning, and well-being. We believe that the daily diary methodology utilized here provided an important source of real-world information about how these constructs are related to each other during the course of everyday experience. The levels of analysis approach that was employed in this study allowed us to ask several different kinds of questions about the relationships between the variables of interest (see Table 1-1).

Positive empathy showed consistent and strong positive associations with prosocial behavior, social functioning, and well-being across all levels of analysis – even after controlling for the effects of the IRI subscales. For example, trait POS showed a positive relationship with trait helping and social connection and a negative relationship with trait loneliness (i.e. trait-trait level). These results were replicated at both the trait-daily and between-subjects daily-daily level; both trait POS and mean daily POS were positively associated with mean daily friend helping, stranger helping, social connection, and life satisfaction and negatively associated with

mean daily loneliness. These associations persisted even at the within-subjects daily-daily level, with daily POS showing the same relationships with all five daily constructs across 14 days. Notably, associations between positive empathy and related constructs were robust and consistent across all levels of analysis, and remained significant after accounting for the effects of PT, EC, and PD. Although past research has not distinguished between empathy for positive and negative emotions, the results of this study demonstrate that positive empathy is a distinct component of empathy that is valuable for predicting a variety of social behaviors and experiences.

Positive Empathy and Prosocial Behavior. Perhaps not surprisingly, our study replicates previous research by showing that traditional components of empathy (i.e. PT, EC, PD) show strong associations with helping at several levels of analysis, jointly predicting up to 40% of the variance in prosocial behavior. This supports the idea that empathizing with others' negative experiences may motivate actions that will reduce others' distress (Batson, 1995; Batson et al., 1989). The current results extend these findings and suggest that positive empathy is also associated with prosocial behavior. Acting prosocially often generates positive emotions in others (e.g. happiness, joy, relief). Thus, individuals who tend to share others' positive emotions may help others because it is vicariously rewarding.

In fact, recent behavioral and neural research shows that engaging in prosocial behavior is rewarding. Individuals report increased positive affect when spending money on others (Dunn, Aknin, & Norton, 2008), helping others (Telzer & Fuligni, 2009; Thoits & Hewitt, 2001), and making sacrifices for others (Kogan et al., 2010). Individuals also show increased neural activity in reward-related regions when giving money to others and supporting others (Harbaugh, Mayr, & Burghart, 2007; Inagaki & Eisenberger, 2011). Based on the consistent association

between positive empathy and prosocial behavior in the current study, we propose that increases in positive affect and reward during prosocial behavior may be due to empathizing with the happiness of the beneficiary. Vicarious positive affect may also reinforce prosocial behavior, explaining why positive empathy is associated with helping at the trait and mean daily levels.

Interestingly, positive empathy and the traditional components of empathy each explained unique variance in prosocial behavior at various levels of analysis. So, negative and positive empathy may each contribute to prosocial motivation, but in different ways. For example, individuals may be moved to help someone because they resonate with his/her distress (i.e. empathic concern) and anticipate the shared joy after helping him/her (i.e. positive empathy). It may also suggest that negative and positive empathy inspire different types of prosocial behavior. Prosocial actions due to negative empathy usually aim to relieve another's negative state (Batson et al., 1989). However, prosocial actions due to positive empathy may not always aim to relieve a negative state and may instead aim to bolster or sustain another's positive state. Positive empathy may motivate prosocial actions such as throwing a party to celebrate a friend's job promotion or giving a birthday gift, actions that amplify another's positive state.

Importantly, different motivations for prosocial behavior may impact the quality of one's social relationships and personal well-being. For example, sacrifices focused on obtaining positive outcomes for others (i.e. approach motives), such as a partner's happiness, were associated with enhanced relationship quality and well-being (Impett, Gable, & Peplau, 2005). In contrast, sacrifices focused on avoiding negative outcomes (i.e. avoidance motives), were negatively associated with relationship quality and personal well-being. Thus, examining the distinct effects of negative and positive empathy on prosocial motivation may provide critical insights into the dynamics of social relationships and personal well-being.

Positive Empathy and Social Functioning. The current study suggests that positive empathy is particularly important for enhanced social functioning. Across all levels of analyses, positive empathy was positively associated with social connection and negatively associated with loneliness. Notably, it was the strongest predictor (compared to PT, EC, and PD) of these outcomes, uniquely predicting about 10-20% of the variance. While past research suggests that trait empathy is positively associated with general social functioning (Davis, 1983a; Jobe & Williams White, 2007), our findings indicate that positive empathy, in particular, is closely tied to increased feelings of social connection and decreased loneliness. Further, we broaden the literature by demonstrating that the association between positive empathy and social connection occurs *within individuals,* as well as across individuals.

While we cannot determine the causal direction of this relationship, it is likely that positive empathy facilitates the creation and maintenance of positive social relationships. Negative empathy may cause the empathizer to feel burdened or upset, in addition to the target of empathy feeling guilty or inadequate for needing emotional support (Shrout, Herman, & Bolger, 2006). In contrast, positive empathy represents an opportunity to connect with others at no cost to the relationship (Gable et al., 2006). Positive empathy in response to another's personal accomplishment or good fortune fosters intimacy because it demonstrates that the empathizer appreciates the personal significance of the good news for the target and highlights the empathizer's own feelings toward the target (e.g. interest, happiness, or pride) (Gable & Reis, 2010). In addition, both the empathizer and target experience positive emotions, leading to a stronger, healthier relationship (Gable et al., 2006; Gable et al., 2004). Further, the target will likely reciprocate with positive empathy and other positive behaviors toward the empathizer (Gable & Reis, 2010; Reis, Clark, & Holmes, 2004). These positive exchanges build

relationships resources – such as trust, satisfaction, commitment, and willingness to sacrifice – that can be drawn on later (Gable et al., 2006). Overall, high levels of positive empathy should foster positive social relationships and make the empathizer feel socially connected.

Reversing the causal direction, feeling socially connected may promote positive empathy, while perceived social isolation may decrease positive empathy. In fact, previous research demonstrates that loneliness is associated with less comfort, intimacy, and understanding during social interactions, as well as more caution, conflict, and distrust (Hawkley, Burleson, Berntson, & Cacioppo, 2003). This general sense of distrust when interacting with others may make it difficult to empathize and connect with others' positive experiences. In contrast, feeling socially connected may make individuals more comfortable in subsequent social interactions and more open to empathizing with others' positive emotions. In addition, a larger number of positive social connections (i.e. high trait social connection) may create more opportunities to experience positive empathy. While the current data cannot determine the causal direction of the relationship between positive empathy and social connection, it is clear that they are intimately related and may even create upward spirals of enhanced social functioning (Fredrickson & Joiner, 2002).

Indeed, the current results suggest that stable measures of positive empathy (i.e. trait and mean daily positive empathy) are positively associated with generally feeling more social connected and less lonely. Interestingly, these relationships hold even on a day-to-day basis within individuals. In other words, individuals with high trait positive empathy and low trait positive empathy both feel more socially connected on days they experience more positive empathy. Taken together, these results suggest that positive empathy may trigger positive exchanges that enhance social connections over time, as well as boosting feelings of social

closeness in the moment. In turn, a strong sense of social connection may motivate individuals to maintain and strengthen social bonds by frequently engaging in positive empathy.

Positive Empathy and Well-Being. In addition to conferring interpersonal benefits, positive empathy may also be associated with intrapersonal benefits, such as increased life satisfaction. Across all levels of analyses, positive empathy was the strongest predictor (compared to PT, EC, and PD) of life satisfaction, uniquely predicting about 5-15% of its variance. At the within-subjects daily-daily level, endorsing one additional positive empathy item was associated with about a half-point increase (on a 7-point scale) in life satisfaction on the same day. Because the causal direction of the relationship between positive empathy and life satisfaction is unclear, there are two possible interpretations of this finding. Positive empathy may enhance life satisfaction because it increases positive affect and satisfaction with social relationships. Alternatively, greater life satisfaction may cause an individual to experience positive empathy more frequently.

Expanding on this first interpretation, positive empathy may boost vicarious positive affect, which in turn helps build personal resources, such as self-acceptance, resilience, and purpose in life. These personal resources can then be used to meet life's challenges and opportunities and increase life satisfaction (Cohn, Fredrickson, Brown, Mikels, & Conway, 2009; Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008). In addition, positive affect has been associated with positive relations with others and increased support giving (Fredrickson et al., 2008). Our results suggest that shared positive affect (i.e. positive empathy) in particular may be partly responsible for these increases in social closeness and prosocial behavior (see above), increases that may enhance relationship satisfaction. In turn, increased relationship satisfaction

may boost general life satisfaction. Overall, positive empathy may build personal and relationship resources that lead to a more fulfilling and satisfying life.

Alternatively, greater life satisfaction may cause individuals to more readily engage in positive empathy, while low life satisfaction may make it difficult to empathize with others' positive experiences. Trying to empathize with another person's happiness when you are dissatisfied and unhappy with your own life may create an "interpersonal empathy gap." An interpersonal empathy gap occurs when one tries to understand the behavior of another person who is in an affective state that is different from one's own (Loewenstein, 2005). The current results show that low life satisfaction is associated with low levels of positive empathy on the same day, suggesting that low life satisfaction may temporarily impair the ability to connect with others' happy moments. Further, mean daily life satisfaction was positively associated with mean daily positive empathy, suggesting that this association is relatively stable over time.

Positive Empathy and Aggression. While positive empathy showed a positive relationship with prosocial behavior, positive empathy showed no significant relationship with antisocial behavior (i.e. aggression) at almost all levels of analysis. The only exception was the within-subjects daily-daily level of analysis that showed a significant negative relationship between daily positive empathy and daily aggression across days. In addition, mean daily positive empathy was negatively associated with mean daily aggression, but was only marginally significant. Thus, positive empathy did show the expected negative relationship with aggression, but correspondence between these two variables was generally weak and inconsistent. Overall, there is little evidence that positive empathy affects aggressive behaviors.

The Value of Trait and Daily Measures of Empathy. Finally, our results suggest that daily empathy measures may be a valuable addition to trait empathy measures when predicting

daily experiences and behaviors. For example, mean daily empathy subscales added an additional 10-30% of explained variance, over and above the effects of their analogous trait subscales, when predicting mean daily friend and stranger helping. In addition, mean daily positive empathy explained significant variance (over and above the effects of trait positive empathy) for almost all of the daily related constructs, including mean daily friend and stranger helping, social connection, loneliness, and life satisfaction. In contrast, mean daily PT, EC, and PD did not prove more valuable than their equivalent trait subscales when predicting the same outcomes. While researchers often use trait scales to approximate or predict daily experiences and behaviors, our results suggest that daily experience sampling sometimes increases the accuracy and validity of these predictions.

Limitations and Conclusion

One limitation in the current investigation is the inability of correlational research to specify direction of effect. This limitation seems particularly relevant for the observed associations between positive empathy and social connection, as it is possible that more extensive social ties provide more opportunities to experience empathy, rather than the other way around. Furthermore, the gain in ecological validity in the present study comes at the cost of experimental control, which makes causal statements about relationships between variables difficult. For example, unlike the experimental work by Batson and colleagues (for a review, see Batson, 1991), we cannot definitively claim that helping observed in this study was the result of empathic emotion, or that helping was altruistically motivated. Despite these limitations, we believe it is quite important to test whether the relationships observed between variables in the laboratory are sustained during the course of daily experience.

Taken together, these results offer new insights into the relationship between empathy and four important constructs that have long been linked together, as well as elucidating the role of positive empathy in empathic processes. This study also highlights the utility of gathering both self-report and daily experience measures, which can be used together to answer various questions at different levels of analysis. While empathy remains a complex topic, gathering evidence of its effects through diverse methodologies allows us to gain further traction on its role in social functioning and better understand the nature of this elusive construct. Going forward, positive empathy may be an important construct to measure and include when studying social experiences, behaviors, and relationships because it so clearly impacts prosocial behaviors, social functioning, and personal well-being.

Table 1-1.
Questions that a levels-of-analysis approach can address

Level	Question	Benefits	Examples
Trait/Trait	Strength of relationship between stable traits	• Measures enduring characteristics • Taps self-concept	Relationship of trait POS with trait social connection
Trait/Daily			
Analogous	Predictive validity of trait scale for analogous real-world behavior	• Source of convergent validity for trait scale	Correspondence between trait PT and daily PT
Related	Predictive validity of trait scale for non-tautological, real-world behavior	• Source of ecological validity for hypothesis	Relationship of trait POS with mean daily life satisfaction
Trait vs Daily			
Analogous	Value of including daily measure in addition to analogous trait measure	• Determines necessity of daily experience sampling	Trait vs. mean daily EC predicting mean daily helping
Daily/Daily			
Between-subjects	Fine-grained relationship between behaviors & emotions	• Non-retrospective • Less introspective • Taps real behavior	Relationship of mean daily EC with mean daily helping
Within-subjects	Covariance between variables across time	• Non-retrospective • Less introspective • Temporal information	Covariance of daily POS and daily loneliness across multiple days

Table 1-2.
Bivariate Correlations of Trait and Daily Empathy with Related Trait & Daily Constructs

	Related Trait Constructs				Related Daily Constructs					
Trait Empathy	Hlp	Aggr	SC	Lone	Frd Hlp	Acq Hlp	Aggr	SC	Lone	SWL
PT	.45*	-.19	.11	-.10	.30*	.23*	-.23*	.28*	-.26*	.22*
EC	.60*	-.28*	.23*	-.16	.26*	.13	-.05	.22*	-.19	.17
PD	.01	.03	-.01	.16	-.08	-.13	.20*	-.18	.20*	-.13
POS	.54*	-.21*	.34*	-.33*	.37*	.28*	-.11	.42*	-.41*	.32*
Daily Empathy	Hlp	Aggr	SC	Lone	Frd Hlp	Acq Hlp	Aggr	SC	Lone	SWL
PT	.31*	-.03	-.02	-.03	.57*	.44*	.17	.21*	-.19	.22*
EC	.39*	-.02	.06	-.15	.61*	.39*	.29*	.08	-.03	.17
PD	.18	.02	.01	.02	.39*	.25*	.32*	-.04	.11	.05
POS	.32*	-.11	.14	-.24*	.66*	.52*	.06	.40*	-.36*	.40*

Note. PT = perspective taking; EC = empathic concern; PD = personal distress; POS = positive empathy. Hlp = helping; Aggr = aggression; SC = social connection; Lone = loneliness; Frd hlp = friend helping; Acq Hlp = acquaintance/stranger helping; SWL = satisfaction with life. * $p < .05$.

Table 1-1.
Questions that a levels-of-analysis approach can address

Level	Question	Benefits	Examples
Trait/Trait	Strength of relationship between stable traits	• Measures enduring characteristics • Taps self-concept	Relationship of trait POS with trait social connection
Trait/Daily			
Analogous	Predictive validity of trait scale for analogous real-world behavior	• Source of convergent validity for trait scale	Correspondence between trait PT and daily PT
Related	Predictive validity of trait scale for non-tautological, real-world behavior	• Source of ecological validity for hypothesis	Relationship of trait POS with mean daily life satisfaction
Trait vs Daily			
Analogous	Value of including daily measure in addition to analogous trait measure	• Determines necessity of daily experience sampling	Trait vs. mean daily EC predicting mean daily helping
Daily/Daily			
Between-subjects	Fine-grained relationship between behaviors & emotions	• Non-retrospective • Less introspective • Taps real behavior	Relationship of mean daily EC with mean daily helping
Within-subjects	Covariance between variables across time	• Non-retrospective • Less introspective • Temporal information	Covariance of daily POS and daily loneliness across multiple days

Table 1-2.

Bivariate Correlations of Trait and Daily Empathy with Related Trait & Daily Constructs

	Related Trait Constructs				Related Daily Constructs					
Trait Empathy	Hlp	Aggr	SC	Lone	Frd Hlp	Acq Hlp	Aggr	SC	Lone	SWL
PT	.45*	-.19	.11	-.10	.30*	.23*	-.23*	.28*	-.26*	.22*
EC	.60*	-.28*	.23*	-.16	.26*	.13	-.05	.22*	-.19	.17
PD	.01	.03	-.01	.16	-.08	-.13	.20*	-.18	.20*	-.13
POS	.54*	-.21*	.34*	-.33*	.37*	.28*	-.11	.42*	-.41*	.32*
Daily Empathy	Hlp	Aggr	SC	Lone	Frd Hlp	Acq Hlp	Aggr	SC	Lone	SWL
PT	.31*	-.03	-.02	-.03	.57*	.44*	.17	.21*	-.19	.22*
EC	.39*	-.02	.06	-.15	.61*	.39*	.29*	.08	-.03	.17
PD	.18	.02	.01	.02	.39*	.25*	.32*	-.04	.11	.05
POS	.32*	-.11	.14	-.24*	.66*	.52*	.06	.40*	-.36*	.40*

Note. PT = perspective taking; EC = empathic concern; PD = personal distress; POS = positive empathy. Hlp = helping; Aggr = aggression; SC = social connection; Lone = loneliness; Frd hlp = friend helping; Acq Hlp = acquaintance/stranger helping; SWL = satisfaction with life. * $p < .05$.

Table 1-3.

Two-Step Hierarchical Linear Regressions with Trait Empathy Predicting Related Trait Constructs

	Related Trait Constructs							
Trait Empathy	Helping		Aggression		Social Connection		Loneliness	
	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
PT	.09	.01	.01	.03	-.07	-.18	.08	.21
EC	.63*	.52*	-.34*	-.32*	.32*	.16	-.30*	-.12
PD	-.20*	-.19*	.16	.15	-.13	-.11	.27*	.25*
POS		.23*		-.04		.36*		-.40*
Adjusted R^2	.40*	.42*	.07*	.07*	.04	.10*	.05*	.14*
R^2 Change		.03*		.00		.07*		.09*

Note. Each set of two columns represents a two-step hierarchical linear regression that included only those independent variables for which estimates are presented. Standardized regression coefficients (betas) are listed. PT = perspective taking; EC = empathic concern; PD = personal distress; POS = positive empathy. *$p < .05$.

Table 1-4.
Bivariate Correlations of Trait Empathy Subscales With Average Daily Empathy Subscales

	Daily Empathy			
Trait Empathy	Daily PT	Daily EC	Daily PD	Daily POS
Trait PT	.38*	.22*	.07	.22*
Trait EC	.32*	.37*	.18	.24*
Trait PD	.01	.12	.27*	-.06
Trait POS	.37*	.37*	.16	.47*

Note. * $p < .05$.

Table 1-5.

Two-Step Hierarchical Linear Regressions with Trait Empathy Predicting Related Daily Constructs

	Related Daily Constructs											
Trait Empathy	Friend Helping		Stranger Helping		Aggression		Social Connection		Loneliness		Satisfaction with Life	
	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
PT	.17	.09	.16	.08	-.23	-.23	.09	-.05	-.12	.01	.11	.01
EC	.21	.09	.10	-.01	.01	.01	.29*	.09	-.22	-.03	.18	.04
PD	-.15	-.13	-.16	-.14	.18	.18	-.27*	-.24*	.27*	.24*	-.18	-.16
POS		.27*		.25		.00		.43*		-.42*		.30*
Adjusted R^2	.09*	.13*	.04	.07*	.06*	.05	.11*	.21*	.10*	.19*	.05*	.09*
R^2 Change		.04*		.03		.00		.10*		.10*		.05*

Note. Each set of two columns represents a two-step hierarchical linear regression that included only those independent variables for which estimates are presented. Standardized regression coefficients (betas) are listed. PT = perspective taking; EC = empathic concern; PD = personal distress; POS = positive empathy. *$p < .05$.

Table 1-6.
Two-Step Hierarchical Linear Regressions with Daily Empathy Predicting Related Daily Constructs

	Related Daily Constructs											
Daily Empathy	Friend Helping		Stranger Helping		Aggression		Social Connection		Loneliness		Satisfaction with Life	
	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
PT	.34*	.23*	.32*	.22*	.02	.08	.23	.10	-.24*	-.11	.18	.06
EC	.36*	.22*	.18	.04	.14	.21	.01	-.17	.01	.19	.10	-.06
PD	.09	.03	.06	.00	.24*	.27*	-.11	-.20	.17	.26*	-.06	-.13
POS		.40*		.38*		-.21		.54*		-.53*		.46*
Adjusted R^2	.43*	.53*	.20*	.28*	.09*	.11*	.03	.20*	.04	.20*	.02	.15*
R^2 Change		.10*		.09*		.03		.17*		.17*		.13*

Note. Each set of two columns represents a two-step hierarchical linear regression that included only those independent variables for which estimates are presented. Standardized regression coefficients (betas) are listed. PT = perspective taking; EC = empathic concern; PD = personal distress; POS = positive empathy. *$p < .05$.

Table 1-7.

Two-Step Hierarchical Linear Regressions with Trait and Daily Empathy Predicting Related Daily Constructs

	Related Daily Constructs											
Trait/Daily Empathy	Daily Friend Helping		Daily Stranger Helping		Daily Aggression		Daily Social Connection		Daily Loneliness		Daily Satisfaction with Life	
	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
Trait PT	.30*	.10	.22*	.07	-.23*	-.35*	.26*	.21*	-.26*	-.22*	.22*	.16
Daily PT		.53*		.41*		.30*		.13		-.10		.16
Adjusted R^2	.08*	.32*	.04*	.18*	.05*	.12*	.06*	.06*	.06*	.06*	.04*	.05*
R^2 Change		.24*		.14*		.08*		.01		.01		.02
Trait EC	.26*	.04	.13	-.01	-.05	-.18	.24*	.25*	-.19	-.21	.18	.13
Daily EC		.59*		.40*		.35*		-.01		.05		.12
Adjusted R^2	.06*	.36*	.01	.14*	-.01	.09*	.05*	.04	.03	.02	.02	.02
R^2 Change		.30*		.14*		.11*		.00		.00		.01
Trait PD	-.08	-.20*	-.13	-.22*	.20*	.12	-.17	-.17	.20*	.18	-.13	-.15
Daily PD		.44*		.31*		.29*		.00		.06		.09
Adjusted R^2	.00	.17*	.00	.09*	.03*	.10*	.02	.01	.03*	.03	.00	.00
R^2 Change		.18*		.09*		.08*		.00		.00		.01
Trait POS	.37*	.07	.28	.04	-.11	-.18	.44*	.32*	-.41*	-.31*	.32*	.17
Daily POS		.63*		.50*		.15		.24*		-.21*		.32*
Adjusted R^2	.13*	.43*	.07	.25*	.00	.01	.18*	.22*	.16*	.19*	.09*	.17*
R^2 Change		.31*		.19*		.02		.05*		.04*		.08*

Note. Each set of two columns represents a two-step hierarchical linear regression that included only those independent variables for which estimates are presented. Standardized regression coefficients (betas) are listed. PT = perspective taking; EC = empathic concern; PD = personal distress; POS = positive empathy. * $p < .05$.

Table 1-8.

Hierarchical Linear Modeling (HLM) Predicting Daily Related Constructs With Each Daily Empathy Subscale

	Daily Related Constructs					
Daily Empathy	Friend Helping	Stranger Helping	Aggression	Social Connection	Loneliness	Satisfaction with Life
PT	.16 (.02)*	.07 (.01)*	.06 (.02)*	.48 (.10)*	-.44 (.09)*	.41 (.13)*
EC	.17 (.02)*	.05 (.01)*	.05 (.02)*	.19 (.09)*	-.16 (.08)*	.08 (.11)
PD	.18 (.03)*	.02 (.02)	.14 (.04)*	-.33 (.20)	.36 (.21)	-.54 (.27)
POS	.13 (.02)*	.07 (.01)*	-.04 (.02)*	.97 (.09)*	-.88 (.09)*	1.35 (.13)*

Note. 24 separate HLM models are represented: each of the 4 daily empathy subscales predicting each of the 6 related daily outcomes. Unstandardized regression coefficients and standard errors (in parentheses) are listed. PT = perspective taking; EC = empathic concern; PD = personal distress; POS = positive empathy. * $p < .05$.

Table 1-9.

Hierarchical Linear Modeling (HLM) Predicting Daily Related Constructs With Simultaneous Daily Empathy Subscales

	Daily Related Constructs					
Daily Empathy	Friend Helping	Stranger Helping	Aggression	Social Connection	Loneliness	Satisfaction with Life
PT	.10 (.02)*	.06 (.01)*	.06 (.02)*	.29 (.11)*	-.30 (.09)*	.22 (.13)
EC	.12 (.02)*	.03 (.01)*	.03 (.02)	.02 (.09)	.00 (.08)	-.12 (.12)
PD	.07 (.03)*	-.02 (.03)	.10 (.04)*	-.43 (.21)*	.45 (.22)*	-.56 (.27)*
POS	.08 (.02)*	.05 (.01)*	-.07 (.02)*	.90 (.10)*	-.83 (.09)*	1.34 (.13)*

Note. Six separate HLM models are represented: daily empathy subscales predicting friend helping; daily empathy subscales predicting stranger helping; daily empathy subscales predicting aggression; daily empathy subscales predicting social connection; daily empathy subscales predicting loneliness; daily empathy subscales predicting satisfaction with life. Unstandardized regression coefficients and standard errors (in parentheses) are listed. PT = perspective taking; EC = empathic concern; PD = personal distress; POS = positive empathy. * $p < .05$.

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Appendix A

Positive Empathy Scale

Instructions: Below are a number of statements that may or may not describe you. Please indicate how much each statement describes you.

1. At a surprise party, I become very excited watching someone react to the surprise.
2. When I see someone else smile, I can't help but smile too.
3. If I don't understand why someone is excited, I try to put myself in their shoes and understand what they're thinking and feeling.
4. When someone else is enthusiastic, I can't help but be enthusiastic too.
5. When someone succeeds at something that I don't think is very important, I can still understand why they're happy.
6. When people talk about their hopes and dreams, I always hope they achieve them.
7. I often feel excited when I'm with other people who are excited.

Response options

1: Does not describe me at all

2: Describes me a little

3: Somewhat describes me

4: Describes me well

5: Describes me very well

Appendix B

Daily Empathy Questionnaire

Instructions: Did you experience any of the following TODAY?

Positive empathy

1. Today, I felt happy that something good happened to someone I know.
2. Today, I celebrated someone else's good news.
3. Today, hearing an inspirational story made me feel uplifted.
4. Today, I felt excited when I saw someone else succeed.

Perspective taking

1. Today, I tried to see things from someone else's point of view.
2. Today, I could appreciate someone else's opinion even though I disagreed with it.
3. Today, I tried to imagine what someone else was thinking or feeling.

Empathic concern

1. Today, I felt sorry for someone who was having a problem.
2. Today, I felt concerned for someone who was in a bad situation.
3. Today, I got emotionally caught up in a friend's problem.

Personal distress

1. Today, seeing someone in trouble made me feel worried and anxious.
2. Today, hearing about someone else's misfortune made me feel tense and scared.
3. Today, I felt uncomfortable when a friend told me something personal.
4. Today, I tried to avoid seeing someone who I knew was upset.

Response options: No / Yes

Note: All items were scrambled prior to administration.

Appendix C

Daily Helping Questionnaires

Instructions: Today, did you do anything to help a GOOD FRIEND (don't count family members or relationship partners), including:

1. Lent a friend an item (tool, clothes, car, etc.)
2. Lent or gave a friend money
3. Helped a friend with schoolwork
4. Listened to a friend who needed to talk about a problem
5. Tried to cheer a friend up
6. Called a friend who was feeling down
7. Helped fix a problem (e.g., a broken computer, change a tire)
8. Helped a friend do chores/errands (e.g., laundry, grocery shopping)
9. Provided a friend helpful information
10. I went somewhere because a friend wanted me to, even though I didn't feel like going

Instructions: Today, did you do anything to help a STRANGER OR ACQUAINTANCE, including:

1. Gave directions
2. Delayed elevator
3. Held open a door
4. Made change
5. Picked up a fallen object for someone
6. Lent or gave money

7. Let someone go ahead of you in line
8. Helped a disabled or elderly person
9. Lent an item of value (tool, clothes, car, etc.)
10. Helped with schoolwork
11. Asked someone if they need help

Response options: No / Yes

Appendix D

Daily Aggression Questionnaire

Instructions: Did you experience any of the following TODAY?

Anger

1. I got mad at someone.
2. I felt irritated or annoyed with someone.
3. I had trouble controlling my temper.

Verbal aggression

1. I told someone who annoyed me what I thought of them.
2. I got into an argument.
3. I said something mean about someone.
4. I talked about someone behind their back.
5. I told someone off.
6. I told someone that I disagreed with them.

Hostility

1. I felt like people were laughing at me behind my back.
2. I felt bitter about things.
3. I gave someone the silent treatment.

Response options: No / Yes

Note: All items were scrambled prior to administration.

Appendix E

Daily Loneliness

Instructions: Please indicate to what extent you felt this way TODAY:

1. I felt close to people.
2. I felt alone.
3. I felt that there were people I could talk to.
4. I felt isolated from others.
5. I felt left out.
6. I could find companionship when I wanted it.

Response options

1: Strongly disagree

2:

3:

4: Neither agree nor disagree

5:

6:

7: Strongly agree

Study 2:

The Neural Components of Empathy:

Implications for Daily Prosocial Behavior

Abstract

Despite a wealth of fMRI studies of empathy, no work has clearly identified the neural systems that support the three components of empathy: perspective-taking, affective congruence, and prosocial motivation. These limitations stem from a focus on a single emotion per study, no variation in the amount of social context provided, and no measurement of the consequences of prosocial motivation (i.e. actual helping behavior). In the current investigation, 32 participants completed an fMRI session assessing empathic responses to individuals experiencing pain, anxiety, and happiness. Outside the scanner, they completed a 14-day experience sampling survey that assessed their real-world helping behaviors. The results demonstrate that (1) empathy for pain activates regions associated with negative affect and the putative mirror neuron system (MNS); (2) empathy for anxiety activates regions associated with negative affect and the mentalizing system (MZS); and (3) empathy for happiness activates regions associated with positive affect and the mentalizing system. The septal area (SA), a region previously linked to prosocial motivation, was the only region that was commonly activated across empathy for pain, anxiety, and happiness. Further, neural activity in SA during each of these empathic experiences was positively associated with daily helping. Taken together, these results suggest that empathy may be evoked through two different pathways, the mirror neuron or mentalizing systems, as well as engaging affective regions that are congruent with the target's emotion. Finally, empathy generally activates the SA, which may drive prosocial behavior in the real world.

The Neural Components of Empathy:

Implications for Daily Prosocial Behavior

Human beings are intensely social creatures who have a need to belong and connect with others (Baumeister & Leary, 1995). Empathy helps create and maintain these social bonds by enabling people to both comprehend, share, and respond appropriately to others' emotional states (Decety & Jackson, 2004). The neural bases of empathy have been a major topic of investigation for the past decade, yet the linkages between major models of empathy and the neural instantiation of the model components has been limited. Multiple models of empathy point to three major components: perspective-taking, congruent affect with the target, and prosocial motivation to help the target (Batson, 1991; Zaki & Ochsner, 2012). Although limbic, mirror neuron, and mentalizing networks have been associated with empathic processing, prior studies have not been able to tease apart their distinct contributions and relationship to each component of empathy (Bruneau, Pluta, & Saxe, 2012; Lamm, Decety, & Singer, 2011; Mobbs et al., 2009; Rameson, Morelli, & Lieberman, 2012; Singer et al., 2004; Spunt & Lieberman, 2012a, 2012b; Zaki, Weber, Bolger, & Ochsner, 2009). These limitations in prior research stem from three issues: focus on a single emotion per study, no variation in the amount of social context provided and no measurement of the consequences of prosocial motivation (e.g. actual helping behavior).

Most notably,studies typically include targets experiencing only a single emotion and that emotional experience is most frequently pain. A recent meta-analysis found that of 40 neuroimaging studies of empathy, 30 focused on empathy for pain (Fan, Duncan, de Greck, & Northoff, 2011). At first glance, meta-analyses appear to confirm the view that dorsal anterior cingulate cortex (dACC) and anterior insula (AI) support core aspects of empathy for the emotions of others (Fan et al., 2011; Lamm et al., 2011). However, it is possible that these

results reflect the undue influence of empathy for pain studies. Given that the dACC and AI are centrally involved in the personal experience of pain and distress (Davis, 2000; Eisenberger, Lieberman, & Williams, 2003; Peyron, Laurent, & García-Larrea, 2000; Rainville, 2002; Shackman et al., 2011), these regions may be specific to affective congruence with a target experiencing pain, rather than being activated more broadly during all empathic experiences.

Comparing empathy for positive and negative experiences (i.e. happiness, pain, and anxiety) within the same study allows us to identify which neural systems support affective congruence for different emotions and which empathic processes are unrelated to affective congruence. In contrast to the large number of neuroimaging studies focusing on empathy for negative emotions, only a handful of studies have examined empathy for positive emotions (Jabbi, Swart, & Keysers, 2007; Mobbs et al., 2009). For example, one study (Jabbi et al., 2007) examined responses to observing positive and negative gustatory experiences; however, their analyses were limited to testing for common responses in a small region of fronto-insular cortex. Another recent study examined empathy for positive emotions in a social context (i.e. watching game show contestants win money), but did not include any conditions measuring empathy for negative emotions. Further, empathy for positive emotions did not activate the dACC or AI (Mobbs et al., 2009) and instead activated ventromedial prefrontal cortex (VMPFC).

A second limitation of prior work is that studies have not varied the mental work required to share the experience of a target, making it difficult to identify neural systems related to the perspective-taking component of empathy. Sometimes it is remarkably easy to step into someone else's shoes and understand what he/she is experiencing. For example, when we see someone accidentally cut their hand with a knife (Hein, Silani, Preuschoff, Batson, & Singer, 2010; Jackson, Meltzoff, & Decety, 2005; Singer et al., 2006), no mental effort is required to

share the target's pain. However, if we see someone who looks distressed (i.e. anguished facial expression), it may be difficult to fully empathize with that person if we don't know why he/she is distressed. In other words, there is no *context* to help us understand the other's mental state. In the first case (i.e. low mental effort), we might expect the mirror neuron system (MNS) to play a role in automatically producing self-other resonance. In the latter case (i.e. high mental effort), the mentalizing system (MZS) might be critical for doing the work to actively put oneself in another's shoes (Spunt & Lieberman, 2012a). A recent meta-analysis by Lamm, Decety, and Singer (2011) provides support for this idea. Across 32 empathy for pain studies, studies that used pictures that clearly showed why targets were in pain (e.g. due to a needle injection) – likely requiring little mental effort to imagine their pain – increased MNS activity. In contrast, studies that used a symbolic cue to indicate the target was in pain – likely requiring significant mental effort to imagine their pain – led to more MZS activity. Nevertheless, no study has ever directly manipulated the amount of social context that is provided about an emotional event that a participant is empathizing with.

In order to more effectively test the three component model of empathy, the current investigation addressed the first two limitations of prior studies by presenting three kinds of empathy targets: targets experiencing pain, anxiety, or happiness. By including targets experiencing both positive and negative emotions, we aimed to identify neural regions that are primarily involved in affective congruence with a particular emotion. Based on prior work, it is reasonable to expect that dACC, AI, and amygdala might be selectively recruited during empathy for pain and anxiety (Davis, 2000; Lamm et al., 2011; Paulus & Stein, 2006; Peyron et al., 2000), whereas ventral striatum (VS) and VMPFC might be selectively recruited during empathy for happiness (Haber & Knutson, 2010; Kim, Shimojo, & O'Doherty, 2011; Knutson,

Adams, Fong, & Hommer, 2001; Mobbs et al., 2009; O'Doherty, 2004). Further, by asking participants to empathize with stimuli that require low mental effort (i.e. pain) or high mental effort (i.e. anxiety and happiness), the differential involvement of the mirror and mentalizing systems could be examined. Physical pain is often easily and automatically understood even with little contextual information, whereas empathizing with another's anxiety or happiness may require more information about the social context/situation that triggered the emotion in order to fully share the other's emotion.

Finally, we address the third and final limitation of prior work by examining the third component of the empathy model: prosocial motivation and its behavioral correlate, helping behavior. Despite the fact that most models of empathy posit prosocial motivation to be the dominant functional consequence of empathy, only a few neuroimaging studies have examined how neural activity during empathy relates to actual helping behavior (Hein et al., 2010; Rameson et al., 2012). In the current investigation, participants completed a two-week daily diary in which they reported on daily episodes of helping behavior. Given that prosocial motivation is considered a critical component of empathy, we hypothesized that helping behavior would be linked to brain regions commonly activated across all target emotions.

Overview

In the current study, participants were scanned as they saw images of targets experiencing positive and negative emotional events embedded in social context (i.e. context-dependent), as well as targets experiencing pain (i.e. context-independent). The positive context-dependent experiences consisted of images of people looking happy along with contextual information (e.g. 'this person just got engaged to the love of their life'). The negative context-dependent experiences consisted of images of people looking anxious along with contextual information

(e.g. 'this person is waiting to find out if they will get laid off'). The painful context-independent experiences consisted of images of people experiencing pain (e.g. hand getting slammed in a car door) with no written contextual information given. To ensure that participants were experiencing empathy, we explicitly instructed them to intentionally empathize with the people in the photos. Outside of the scanner, participants also completed a daily survey on their helping behaviors for 14 consecutive nights.

Methods

Participants

Informed consent was obtained from 32 healthy, right-handed UCLA undergraduates (16 male, mean age=19.9, *SD*=1.4) who were told the purpose of the study was to learn how emotion is processed in the brain.

fMRI Task

During the fMRI task, participants were asked to empathize with multiple blocks of photos depicting individuals experiencing pain, anxiety, and happiness (see Figure 2-1). For these "empathy" conditions, participants were instructed to empathize with the individuals in the photos and imagine how they felt in that situation. In addition, participants viewed neutral images of people performing everyday actions. These blocks were presented across four functional runs.

Empathy for pain condition. The empathy for pain condition was adapted from Jackson and colleagues (Jackson et al., 2005) and used with their permission. Participants were asked to focus on how painful they thought it would be for the person in each situation and viewed pictures of people experiencing physical pain (e.g. hand slammed in car door). The empathy for

pain condition consisted of two blocks with each block displaying 16 photos for two seconds, with 12-s rest periods separating blocks.

Empathy for anxiety and happiness conditions. The empathy for anxiety and happiness conditions were piloted and designed by the authors. Participants were told to take each target's perspective and imagine how he/she felt about the situation and how it affected his/her life. Each block consisted of a contextual sentence describing a situation followed by six photos depicting different individuals in that situation. The empathy for anxiety and empathy for happiness conditions each consisted of three blocks. Sentences and photos were presented for 4 s each, with 12-s rest periods separating blocks.

Anxiety situations described events such as riding on a plane with dangerous turbulence, waiting to find out about getting laid off, and potentially not being able to pay rent. Happy situations included wining the lottery, getting engaged, and winning an important sporting event. An arrow indicated the target individual if a photo depicted multiple people. Participants were told photos depicted real events drawn from news stories, documentaries, and blogs. Within each block, half of the targets were male and half female. Images were selected from a larger pool in order to equate them on a number of features (i.e. arousal, valence, luminance, and complexity). Subjective ratings of valence and arousal were made by 16 (8 male) undergraduate pilot judges.

Neutral condition. The neutral condition consisted of two blocks in which participants viewed photos of people performing everyday actions (e.g. ironing, cutting vegetables) (adapted from Jackson et al., 2005). Each block displayed 16 photos for two seconds, with 12-s rest periods separating blocks. These blocks served as a neutral condition to compare to "empathy" conditions.

fMRI Acquisition and Data Analysis

Scanning was performed on a Siemens Trio 3T. Functional images were acquired using an EPI gradient-echo sequence (TR=2000 ms, TE=30 ms, 4 mm slice thickness/no gap, FOV=19.2 cm, matrix=64x64, flip angle=90°). A T2-weighted structural image was acquired coplanar with the functional images (TR=5000 ms, TE=34 ms, 4 mm slice thickness/no gap, FOV=19.2 cm, matrix=128x128, flip angle=90°). All images were scalped using the Brain Extraction Tool of FSL (FMRIB Software Library; Oxford University, Oxford, UK) and realigned within runs using MCFLIRT. Images were then checked for residual motion and noise spikes using a custom automated diagnostic tool (thresholded at 2mm motion or 2% global signal change from one image to the next). In SPM8 (Wellcome Department of Imaging Neuroscience, London), all functional and anatomical images were reoriented to set the origin to the anterior commissure and the horizontal (*y*) axis parallel to the AC-PC line. Also in SPM 8, functional images were realigned within and between runs to correct for residual head motion, and coregistered to the matched-bandwidth structural scan using a 6-parameter rigid body transformation. The coregistered structural scan was then normalized into Montreal Neurological Institute (MNI) standard stereotactic space using the scalped ICBM152 template and the resulting parameters were applied to all functional images. Finally, the normalized functional images were resliced into voxels of $3mm^3$ and smoothed using an 8 mm full width at half maximum Gaussian kernel.

All single subject and group analyses were performed in SPM8. First-level effects were estimated using the general linear model and employing a canonical hemodynamic response function convolved with the experimental design. Low-frequency noise was removed using a high-pass filter. Group analyses were conducted using random-effects models to enable

population inferences (Friston, Holmes, Price, Büchel, & Worsley, 1999). To keep all conditions as well-constrained and equivalent as possible, image presentation was modeled separately and used for all first-level contrasts. The contextual sentences in the empathy for anxiety and happiness conditions were modeled separately and were not included in the baseline condition.

Whole-brain group-level analyses were performed using an uncorrected *p*-value of <.005 with a cluster threshold of 43 based on a Monte Carlo simulation in AFNI's Alphasim effectively producing an FDR of p=.05 (Lieberman & Cunningham, 2009). For visualization of results, group contrasts were overlaid on a surface representation of the MNI canonical brain using the SPM surfrend toolbox (http://spmsurfrend.sourceforge.net) and NeuroLens (http://www.neurolens.org/), as well as MRIcron (Rorden, Karnath, & Bonilha, 2007).

Daily Helping Checklist

For 14 evenings in a row, an email was sent to each participant at 5 pm with a link to time-stamped online survey about helping behaviors (i.e. SurveyMonkey). Participants were instructed to complete the survey immediately before going to bed at night. Daily helping was measured with 11-item checklist asking about helping a stranger/acquaintance. They indicated whether they had performed each of the following actions by selecting yes or no: gave directions, delayed elevator, held open a door, made change, picked up a fallen object for someone, lent or gave money, let someone go ahead of you in line, helped a disabled or elderly person, lent an item of value (tool, clothes, car, etc.), helped with schoolwork, and asked someone if they need help.

Items for this scale were selected based on the ratings of 17 pilot judges in an effort to select high-frequency items. Several items were adapted from the Self-Report Altruism Scale (Rushton, Chrisjohn, & Fekken, 1981). No measure of helping friends, family members, or

romantic partners was included because help given to close others and strangers differ in nature (Amato, 1990). In addition, we wanted to simulate previous studies linking empathy and helping behavior towards strangers (Batson, 1991, 1995, 2011; Batson, Duncan, Ackerman, Buckley, & Birch, 1981). For all questions on the daily helping scales, a "no" was coded as 0 because the event did *not* occur, while a "yes" was coded as a 1. Scores for each day were computed by summing the responses to each of the 11-items. A mean daily score were then calculated by averaging the total score across the 14 days. Because this measure was a count of experiences, it was not appropriate to calculate alpha coefficients.

Results

Daily Helping Descriptives. On average, participants completed 13.26 out of 14 daily surveys (*SD* = .89). Overall, individuals reported doing at least one helpful thing for a stranger or acquaintance on 85% of the days. Averaging across the 14 days, individuals endorsed an average of 2.47 out of 11 stranger helping items per day (*SD* = 1.39 items).

Neural correlates of empathy for pain, anxiety, and happiness. The first set of analyses aimed to examine neural activation during each of the empathy conditions compared to the neutral condition (i.e. Pain > Neutral; Anxiety > Neutral; Happiness > Neutral). As in previous research, empathy for pain increased activation in regions associated with negative affect, dACC and bilateral AI (Table 2-1; Figure 2-2, top panel). In addition, empathy for pain activated regions in the MNS, including the intraparietal lobule (IPL), inferior frontal gyrus (IFG), and posterior supplementary area (SMA) (Spunt & Lieberman, 2012b). Interestingly, the septal area (SA), a region associated with caregiving and prosocial sentiments (Inagaki & Eisenberger, 2011; Krueger et al., 2007; Moll et al., 2011; Slotnick & Nigrosh, 1975; Stack,

Balakrishnan, Numan, & Numan, 2002) also showed increased activation. No activations were present in the MZS in this contrast.

Empathy for anxiety also elevated neural activation in the same negative affective regions as empathy for pain, the dACC and bilateral AI, along with the amygdala (Table 2-1; Figure 2-2, middle panel). In addition, empathy for anxiety engaged neural regions in the MZS, including the dorsomedial (DMPFC) and medial prefrontal cortex (MPFC) (Frith & Frith, 2006; Mitchell, 2009; Spunt & Lieberman, 2012b). As with empathy for pain, neural activation in SA was boosted during empathy for anxiety. No activations occurred in the MNS.

In contrast to empathy for pain and anxiety, empathy for happiness increased activation in a region associated with positive affect and reward, the ventromedial prefrontal cortex (VMPFC) (Table 2-1; Figure 2-2, bottom panel). Further, several regions associated with the MZS showed increased activation during empathy for happiness, including the MPFC, DMFPC, temporoparietal junction (TPJ), precuneus, and temporal pole. As with empathy for pain and anxiety, empathy for happiness elevated neural activity in SA.

Differential activation during empathy for pain versus anxiety. In order to compare empathy for context-independent situations with context-dependent situations, we contrasted neural activity during empathy for pain and anxiety. Empathy for pain versus anxiety (i.e. Pain > Anxiety) showed increased bilateral activation in regions associated with the MNS, such as IPL and IFG (Table 2-2; Figure 2-3, top left quadrant). Empathy for pain relative to anxiety also showed increased activation in dACC. The reverse contrast, Anxiety > Pain (Table 2-2; Figure 2-3, top right quadrant), showed increased activation in the MZS, including MPFC, TPJ, and precuneus.

Differential activation during empathy for pain versus happiness. We next compared empathy for pain to empathy for happiness. Empathy for pain relative to happiness (i.e. Pain > Happiness) showed robust activation in the MNS in bilateral IPL, IFG, and posterior SMA (Table 2-3; Figure 2-3, bottom left quadrant). Further, empathy for pain increased activity in neural regions related to negative affect, dACC and bilateral AI, compared to empathy for happiness. Empathy for happiness compared to pain (i.e. Happiness > Pain) lead to elevated levels of neural activation in several regions associated with the MZS, including MPFC, DMPFC, TPJ, and precuneus (Table 2-3; Figure 2-3, bottom right quadrant). In addition, empathy for happiness (versus pain) showed increased activation in VMPFC, a region previously associated with positive affect.

Differential activations during empathy for anxiety versus happiness. We next compared empathy for anxiety and happiness. Empathizing with anxiety relative to happiness (i.e. Anxiety > Happy) was associated with dACC and AI – regions previously associated with empathy for negative emotions (Table 2-4; Figure 2-4, top panel). Empathizing with happiness relative to anxiety (i.e. Happy > Anxiety) was associated with activity in VMPFC (see Table 2-4; Figure 4, bottom panel) – a region related to positive affect.

Common activations during empathy for pain, anxiety, and happiness. To determine whether there were core regions associated with diverse types of empathic experiences, we conducted a conjunction analysis (Nichols, Brett, Andersson, Wager, & Poline, 2005). The conjunction analysis identified regions active when empathizing with targets experiencing pain, anxiety, and happiness (i.e. conjunction of Pain > Neutral, Anxiety > Neutral, and Happy> Neutral). At $p < .005$ with a voxel extent of 43 voxels, no common regions emerged. In order to examine whether common activations in smaller neural regions (e.g. septal area, amygdala) were

being missed due to the large voxel extent, we slightly lowered the voxel extent to 30 voxels. Only one region emerged as active during empathy for all three emotions, the septal area (peak voxel at $x = 6$, $y = 2$, $z = 7$; $t = 3.24$; 34 voxel extent) (see Figure 5, top right quadrant). Thus, empathizing with pain, anxiety, and happiness activates one common neural region, a region that is often associated with prosocial motivation.

Correlations between septal area and daily helping. In this last set of analyses, we wanted to investigate whether SA activation during empathy was a neural indicator of prosocial motivation. Specifically, we examined whether SA activation was associated with increased helping in daily life. To test this idea, we extracted parameter estimates from the functional cluster in SA identified in the conjunction analysis (see above) for each empathy condition compared to the neutral condition (i.e. Pain > Neutral, Anxiety > Neutral, and Happiness > Neutral). Then, average neural activity in the SA for each contrast was correlated with mean daily helping (see Figure 5). Average neural activity in SA for Pain > Neutral and mean daily helping were significantly correlated, $r(30) = .35$, $p < .05$. Average neural activity in SA for Anxiety > Neutral and mean daily helping were also significantly correlated, $r(30) = .39$, $p < .05$. Lastly, average neural activity in SA for Happiness > Neutral and mean daily helping were significantly correlated, $r(30) = .45$, $p < .05$. These results suggest that SA activation during a variety of empathic experiences consistently relates to daily helping and may represent a neural marker of prosocial motivation.

Discussion

Three patterns of results emerged from our data. First, regions associated with negative affect, dACC and AI, were active when empathizing with targets experiencing pain and anxiety, but not with happy targets. On the other hand, VMPFC, a region associated with positive affect,

was active when empathizing with happy targets, but not targets experiencing pain or anxiety. Second, the mirror neuron system was more active during empathy for pain, whereas the mentalizing system was more active during empathy for anxiety and happiness. Finally, the septal area was the only region that was commonly activated during empathy for pain, anxiety, and happiness. Moreover, SA activity was consistently associated with helping behavior in daily life. Here, we discuss the results in terms of their implications for the three-component model of empathy.

Affective Congruence

Numerous studies on the neuroscience of empathy have shown reliable activation of the dACC and AI. This has led to the impression that these two regions are core components of the human capacity for empathy writ large. However, this interpretation was limited by the fact that the vast majority of these studies focused on pain, which produces strong dACC and AI during the first-hand experience of pain. From these studies alone, it was unclear whether dACC and AI occur during empathy for pain experiences because they are involved in empathy in general or because they are invoked when empathizing with this particular experience.

The current results suggest that dACC and AI are not universally involved in empathy. Rather, activation in dACC and AI seems to be specific to empathy for negative emotions, representing affective congruence with the target's pain or anxiety. Notably, dACC and AI activation did not occur during empathy for positive emotion. Instead, empathy for happiness activated VMPFC which has been identified in numerous studies on positive affect and pleasure (Berridge & Kringelbach, 2008; Haber & Knutson, 2010; Kringelbach, 2005; O'Doherty, 2004), Our findings support the notion of affective congruence by recruiting brain regions commonly

associated with the experience of positive and negative affect during the act of empathizing with another's positive or negative affect, respectively.

Generating a Shared Experience

While the three-component model of empathy suggests that perspective-taking is critical for generating affective congruence, the current results suggest that perspective-taking is not the only route to shared emotional experiences. In line with emerging evidence in the literature, we suggest that there are two pathways to generating empathy (Lamm et al., 2011; Zaki & Ochsner, 2012). In the current study, empathizing with emotional experiences that required little mental effort and contextual information to understand (i.e. empathy for pain) engaged the MNS, possibly in the service of generating self-other resonance. Specifically, empathy for pain relative to empathy for anxiety and happiness showed robust activation in IPL, IFG, and posterior SMA. In contrast, empathizing with emotional experiences that required significant mental effort and social context to understand (i.e. empathy for anxiety and happiness) relied on the MZS to promote adequate perspective-taking and subsequent affective congruence. Specifically, MPFC and DMPFC were more active during empathy for anxiety and happiness compared to empathy for pain. Further, previous neuroimaging work provides additional evidence that empathy for context-dependent experiences draw on the MZS, showing increased activation in MPFC and DMPFC during empathy for social rejection, social suffering, sadness, and positive and negative life events (Bruneau et al., 2012; Masten, Morelli, & Eisenberger, 2011; Meyer et al., 2012; Rameson et al., 2012; Zaki et al., 2009).

Prosocial Motivation

Despite the fact that most models of empathy consider prosocial motivation to be a key component of empathy, past studies have not identified a common neural region that is (1)

activated across empathic experiences and (2) associated with prosocial behavior. In the current study, we found that empathy for pain, anxiety, and happiness all activated SA and the functional overlap in SA activation during empathy for each of these emotions correlated with daily helping behavior. While SA is a largely unexamined region within social neuroscience (c.f. Krueger et al., 2007; Moll et al., 2011), animal research suggests that it plays a key role in maternal caregiving and prosocial motivation. Mice with septal lesions fail in all areas of maternal caregiving (Febo, Numan, & Ferris, 2005), and oxytocin receptors in SA are associated with maternal responsiveness (Francis, Champagne, & Meaney, 2000). One functional role of this region is to help new mothers treat their infants like kin rather than as to-be-avoided strangers (Francis et al., 2000). In neuroimaging studies on humans, SA activation has been associated with a variety of prosocial emotions and behaviors, including unconditional trust (Krueger et al., 2007), prosocial sentiments (Moll et al., 2011), charitable donations (Moll et al., 2006), empathic concern and perspective-taking (Rankin et al., 2006), and giving support to loved ones (Inagaki & Eisenberger, 2011).

Thus, SA activation during empathy may serve as a neural maker for prosocial motivation and predict later prosocial behavior. A series of behavioral studies has already demonstrated that empathic emotion is a source of altruistic motivation that predicts increased helping (Batson et al., 1981; Toi & Batson, 1982). Our results extend this finding by identifying a potential neural basis for prosocial motivation which can be used to predict general patterns of prosocial behavior in real life (rather than in an experimental setting).

Conclusions

Our results suggest that there are several neurocognitive components involved in different aspects of empathy. First, limbic regions like dACC, AI, and VMPFC are involved in

affective congruence, supporting an emotional state that mirrors or complements that of the target. Second, the MNS and MZS represent two pathways to sharing others' emotions and are differentially engaged depending on the amount of mental effort it takes to understand another's emotional experience. Finally, SA appears to play a role in generating prosocial motivation during empathy more generally. In particular, the septal area may produce an other-focused, caregiving state of mind that motivates prosocial behavior.

Overall, these results shed new light on past empathy research and may suggest a more comprehensive neural model for empathy. The current findings suggest that the target's specific emotions will stimulate congruent emotions in the observer, such as negative affect when experiencing empathy for negative emotions and positive affect when experiencing empathy for positive emotions. In addition, understanding another's emotions may occur automatically when observing the target or after more consciously taking a target's perspective. Finally, empathy heightens our focus on and concern for others, regardless of what specific emotion the target is experiencing, and motivates us to behave prosocially.

However, it is still unclear how these different components of empathy interact and unfold in real-time (Zaki & Ochsner, 2012). For example, it may be that prosocial motivation heightens the affective response to the target or that the affective response to the target bolsters prosocial motivation. It is also unclear whether MNS and affective regions are activated simultaneously or sequentially. Further, current theories about empathy might suggest that MZS should always precede affective congruence when empathizing with context-dependent emotions. Thus, future studies will be able to explore these questions by examining the temporal sequencing of activation in neural regions associated with affective congruence (e.g. dACC,

insula; VMPFC), mirroring or mentalizing (i.e. MNS and MZS), and prosocial motivation (i.e. SA).

Table 2-1. Neural regions that were more active during empathy for pain, anxiety, and happiness compared to the neutral condition.

Region	BA	Hemisphere	*k*	Coordinates *x*	*y*	*z*	*t*
Pain > Neutral							
Septal area	-	R	4318[1]	12	2	10	4.86
Dorsal anterior cingulate cortex	32/24	R	4318[1]	3	17	28	7.29
Anterior insula	13	R	4318[1]	42	5	1	5.38
		L	4318[1]	-33	20	10	4.46
Inferior frontal gyrus	6/44	R	4318[1]	42	11	22	5.47
		L	4318[1]	-57	2	22	8.44
Inferior parietal lobule/ supramarginal gyrus	40/2	R	416	57	-37	37	3.93
		L	820	-39	-40	43	5.56
Supplementary motor area	6	L	4318[1]	-9	2	61	7.60
Postcentral gyrus	40	R	69	27	-46	55	4.30
Putamen	-	R	66	30	-19	-5	4.12
Occipital lobe	19	R	1666	45	-70	1	8.34
		L	1380	-51	-70	7	8.21
Anxiety > Neutral							
Septal area	-	R	336[2]	3	-1	4	4.30
Medial prefrontal cortex/ dorsomedial prefrontal cortex	10/9	R	202	6	56	22	4.39
Dorsal anterior cingulate cortex	32/24	-	521[3]	0	29	25	4.52
Anterior insula	13	R	185	33	8	10	4.08
		L	228	-39	8	-2	4.02
Supplementary motor area	6	R	521[3]	6	11	67	4.18
Amygdala/hippocampus	-	R	336[2]	18	-4	-8	5.88
		L	336[2]	-18	-10	-14	4.96
Happiness > Neutral							
Septal area	-	R	86	3	-1	1	4.43
Medial prefrontal cortex/ dorsomedial prefrontal cortex	10/9/8	R	473[4]	6	59	13	5.94
Dorsomedial prefrontal cortex	8	R	87	9	44	55	4.51
Precuneus	31	R	43	3	-58	25	4.02
Temporoparietal junction	40	R	625[5]	54	-43	19	6.16
Temporal pole	21/38	L	473[4]	-45	11	-17	4.49
Ventromedial prefrontal cortex	11	-	473[4]	0	47	-14	5.83
Hippocampus/amygdala	-	R	235	21	-10	-11	5.77
		L	67	-18	-10	-14	5.30
Occipital lobe	19	R	625[5]	42	-55	-14	6.98
	18/19	R	286	6	-94	7	4.36

Note. Threshold used was $p<.005$ and 43 voxel extent which provides FDR corrected $p<.05$. BA refers to putative Brodmann's Area; L and R refer to left and right hemispheres; *k* refers to the

cluster size (in voxels); x, y, and z refer to MNI coordinates in the left-right, anterior-posterior, and interior-superior dimensions, respectively; *t* refers to the t-score at those coordinates (local maxima). [1-5] These originate from the same larger cluster.

Table 2-2. Neural regions that were more active during empathy for pain compared to empathy for anxiety or more active during empathy for anxiety compared to empathy for pain.

Region	BA	Hemisphere	*k*	Coordinates *x*	*y*	*z*	*t*
Pain > Anxiety							
Dorsomedial prefrontal cortex	8	R	57	6	35	49	4.67
Dorsal anterior cingulate cortex	24	L	134	-6	5	32	5.10
Inferior frontal gyrus	44/6	R	1185	51	5	37	6.10
		L	12625[1]	-51	5	22	7.94
Inferior parietal lobule/ supramarginal gyrus	40/39	R	12625[1]	57	-22	46	8.64
		L	12625[1]	-51	-31	49	10.56
Posterior cingulate	31	L	53	-15	-25	40	5.02
Thalamus	-	R	279	18	-28	10	5.39
Occipital lobe	19/18	R	12625[1]	33	-79	25	10.07
		L	12625[1]	-45	-67	-5	13.68
Anxiety > Pain							
Medial prefrontal cortex	10/9	-	943[2]	0	53	4	4.19
Precuneus	7/31	R	397[3]	3	-58	37	3.83
Angular gyrus/ inferior parietal lobule	39/40	R	138	54	-64	34	5.43
		L	147	-54	-67	37	5.76
Rostral anterior cingulate cortex	32/24	-	943[2]	0	29	-5	4.64
Middle temporal gyrus	21	R	56	60	-10	-11	4.09
Middle temporal gyrus/ temporal pole	21/38	L	77	-45	8	-17	3.82
Precentral gyrus/postcentral gyrus	3/4	L	78	-42	-25	67	6.20
Occipital lobe	18/19	L	397[3]	-3	-91	28	4.82

Note. Threshold used was $p<.005$ and 43 voxel extent which provides FDR corrected $p<.05$. BA refers to putative Brodmann's Area; L and R refer to left and right hemispheres; *k* refers to the cluster size (in voxels); x, y, and z refer to MNI coordinates in the left-right, anterior-posterior, and interior-superior dimensions, respectively; *t* refers to the t-score at those coordinates (local maxima). [1-3] These originate from the same larger cluster.

Table 2-3. Neural regions that were more active during empathy for pain compared to empathy for happiness or more active during empathy for happiness compared to empathy for pain.

Region	BA	Hemisphere	*k*	Coordinates *x*	*y*	*z*	*t*
Pain > Happiness							
Dorsal anterior cingulate cortex	32/24	L	12896[1]	-3	5	34	8.90
Anterior inusla	13	R	12896[1]	39	17	-2	3.18
		L	12896[1]	-33	20	10	4.62
Inferior frontal gyrus	44	R	12896[1]	60	11	10	5.07
		L	12896[1]	-54	5	28	10.35
Inferior parietal lobule/ supramargingal gyrus	40	R	12896[1]	36	-37	46	7.92
		L	12896[1]	-51	-31	49	12.41
Supplementary motor area	6	-	12896[1]	0	32	49	4.90
Posterior insula	13	R	12896[1]	39	-10	1	5.48
		L	12896[1]	-42	-4	10	9.58
Superior parietal lobule	7	R	12896[1]	21	-67	46	10.10
		L	12896[1]	-18	-64	61	9.54
Dorsolateral prefrontal cortex	46/9	R	12896[1]	39	47	19	4.72
		L	12896[1]	-39	32	37	5.88
Middle frontal gryus/ superior frontal gyrus	6	R	533	24	-4	52	8.00
Middle temporal gyrus	37	R	763[2]	48	-61	-2	8.30
Thalamus	-	L	12896[1]	-15	-16	13	5.56
Cerebellum/occipital lobe	19	R	763[2]	24	-67	-23	6.44
Happiness > Pain							
Medial prefrontal cortex/ dorsomedial prefrontal cortex	10/9	R	722[3]	3	59	7	6.28
Precuneus	7/31	R	495	3	-58	37	7.46
Temporoparietal junction	39/40	R	478	54	-43	16	5.08
Ventromedial prefrontal cortex	11	-	722[3]	0	38	-14	6.52
Middle temporal gyrus/ temporal pole	21/38	R	133	57	-7	-11	6.81
		L	162	-54	-4	-17	5.26
Hippocampus/amygdala	-	R	148	21	-7	-8	4.96
Angular gyrus/ Inferior parietal lobule	39	L	131	-45	-73	43	6.58
Superior frontal gyrus	8	R	155	15	41	52	4.92
Cerebellum	-	R	60	6	-52	1	4.25
Occipital lobe	18/19	-	502	0	-91	16	7.12

Note. Threshold used was p<.005 and 43 voxel extent which provides FDR corrected p<.05. BA refers to putative Brodmann's Area; L and R refer to left and right hemispheres; *k* refers to the cluster size (in voxels); x, y, and z refer to MNI coordinates in the left-right, anterior-posterior,

and interior-superior dimensions, respectively; *t* refers to the t-score at those coordinates (local maxima). [1-3] These originate from the same larger cluster.

Table 2-4. Neural regions that were more active during empathy for anxiety compared to empathy for happiness or more active during empathy for happiness compared to empathy for anxiety.

Region	BA	Hemisphere	*k*	Coordinates *x*	*y*	*z*	*t*
Anxiety > Happiness							
Dorsal anterior cingulate cortex	32/24	L	1201	-3	29	31	5.87
Anterior insula	13	R	1372	39	14	4	5.23
		L	1653	-36	11	-8	6.27
Posterior cingulate	31	R	1201	6	-31	46	4.90
Inferior parietal lobule/ supramarginal gyrus	40	R	1372	63	-31	49	5.83
		L	1653	-42	-1	10	6.28
Posterior insula	13	R	1372	42	-22	7	4.34
		L	1653	-42	-1	10	6.28
Superior frontal gyurs/ middle frontal gyrus	10/9	R	363	21	47	28	4.87
		L	376	-36	35	37	4.93
Happiness > Anxiety							
Precuneus	7	-	88	0	-58	40	4.72
Ventromedial prefrontal cortex	11	-	66	0	50	-11	4.84
Dorsolateral prefrontal cortex	9/46	R	392	54	23	37	4.28
Middle temporal gyrus	21	R	63	60	-7	-14	5.11
		L	57	-60	-13	-14	3.88
Superior parietal lobule	7	L	102	-24	-64	58	4.76
Precentral gyrus	9	L	83	-39	5	34	4.19
Occipital lobe	18/19	R	5567	27	-88	1	10.68
		L	5567	-30	-82	-5	12.74

Note. Threshold used was p<.005 and 43 voxel extent which provides FDR corrected p<.05. BA refers to putative Brodmann's Area; L and R refer to left and right hemispheres; *k* refers to the cluster size (in voxels); x, y, and z refer to MNI coordinates in the left-right, anterior-posterior, and interior-superior dimensions, respectively; *t* refers to the t-score at those coordinates (local maxima). [1-5]These originate from the same larger cluster.

Figure Captions

Figure 2-1. Examples of what participants saw for blocks of empathy for pain, anxiety, and happiness, as well as blocks of neutral stimuli. Analyses focused on the time periods when pictures were shown. The time when contextual statements were shown prior to anxiety and happiness blocks were not included in the fMRI analyses.

Figure 2-2. Neural regions that were more active during empathy for pain, anxiety, and happiness each compared to the neutral condition.

Figure 2-3. Neural regions that were more active during empathy for pain compared to empathy for anxiety and happiness, as well neural regions that were more active during empathy for anxiety and happiness compared to empathy for pain.

Figure 2-4. Neural regions that were more active during empathy for anxiety compared to empathy for happiness or more active during empathy for happiness compared to empathy for anxiety.

Figure 2-5. The functional overlap in the septal area produced from the conjunction of each empathy condition compared to the neutral condition. No other region was present in the conjunction of each empathy condition. The scatterplots illustrate the correlation of average activity in the septal area for empathy for pain, anxiety, and happiness with average daily helping. Each point represents a single participant.

Figure 2-1.


Pain
Anxiety
This person is waiting to find out if they will get laid off.
Happiness
This person just got engaged to the love of their life.
Neutral
Stimuli used in fMRI analyses

Figure 2-2.

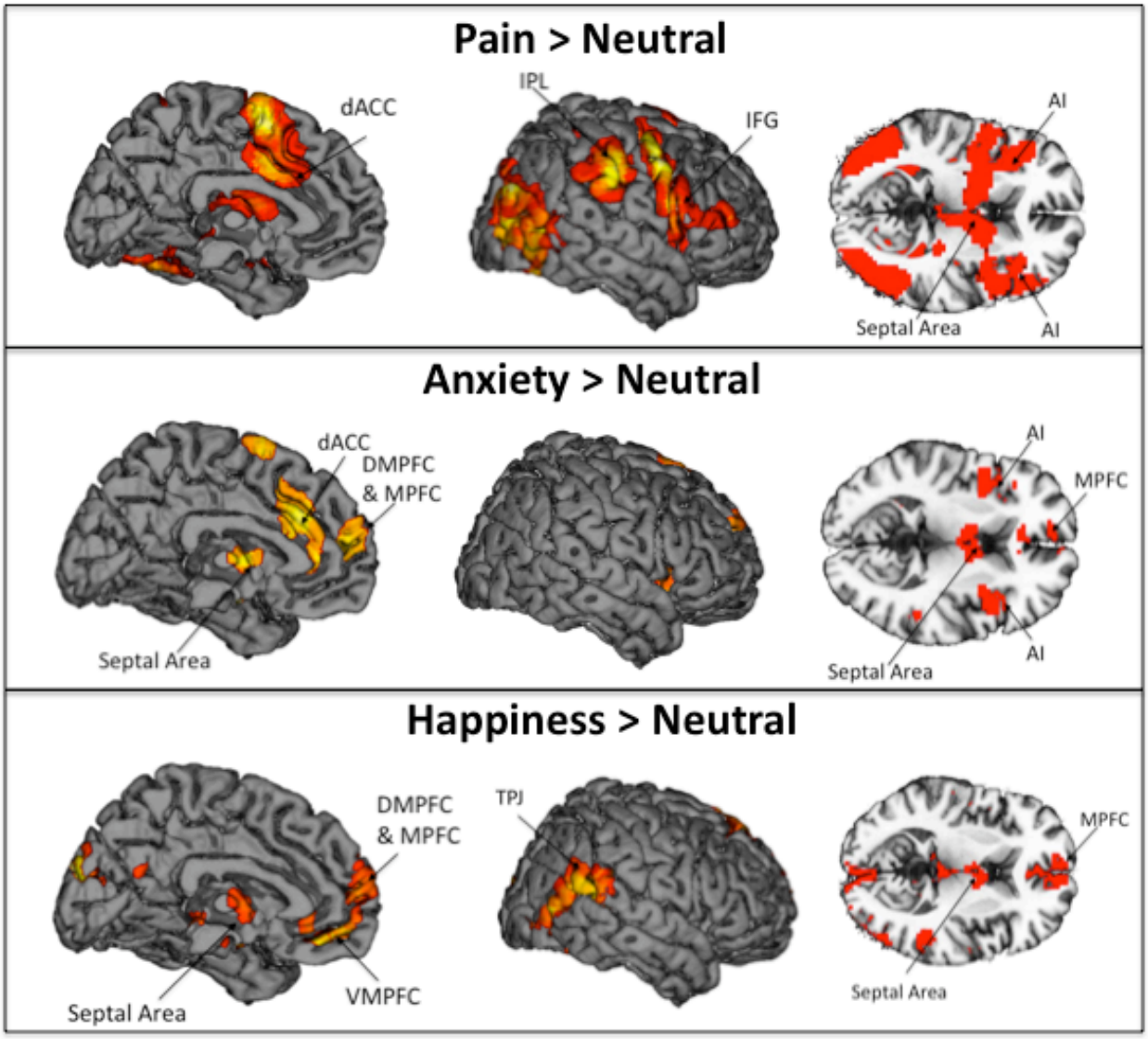

Pain > Neutral
dACC
IPL
IFG
AI
Septal Area
AI
Anxiety > Neutral
dACC
DMPFC
& MPFC
Septal Area
AI
MPFC
AI
Septal Area
Happiness > Neutral
DMPFC
& MPFC
Septal Area
VMPFC
TPJ
MPFC
Septal Area

Figure 2-3.

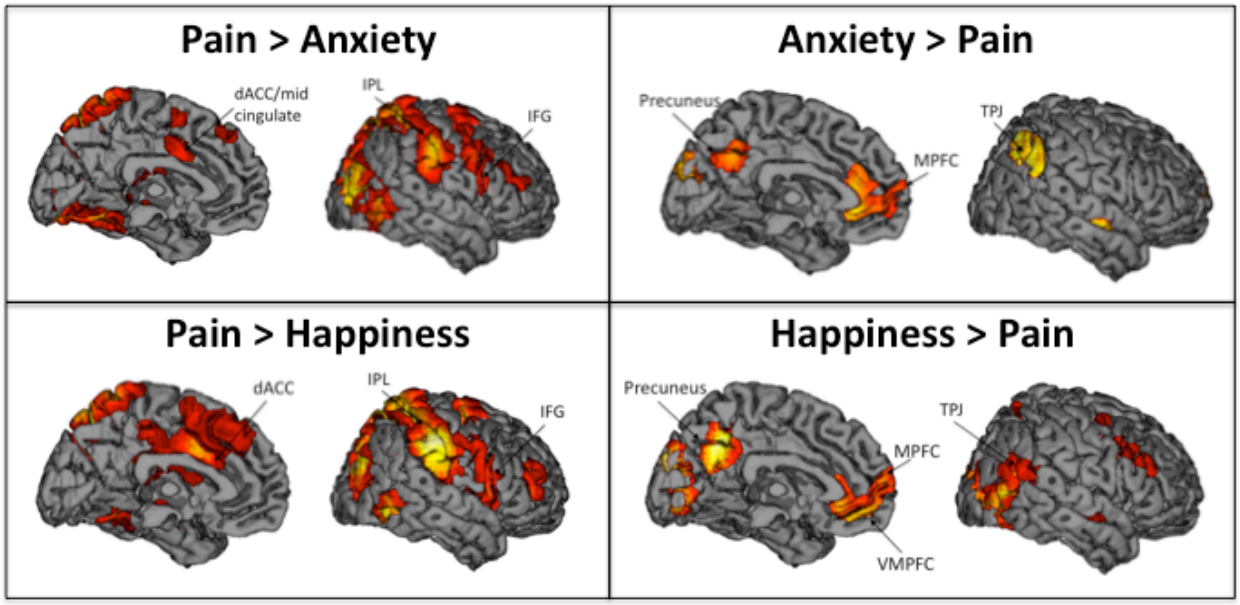

Pain > Anxiety
dACC/mid cingulate
IPL
IFG
Anxiety > Pain
Precuneus
MPFC
TPJ
Pain > Happiness
dACC
IPL
IFG
Happiness > Pain
Precuneus
MPFC
VMPFC
TPJ

Figure 2-4.

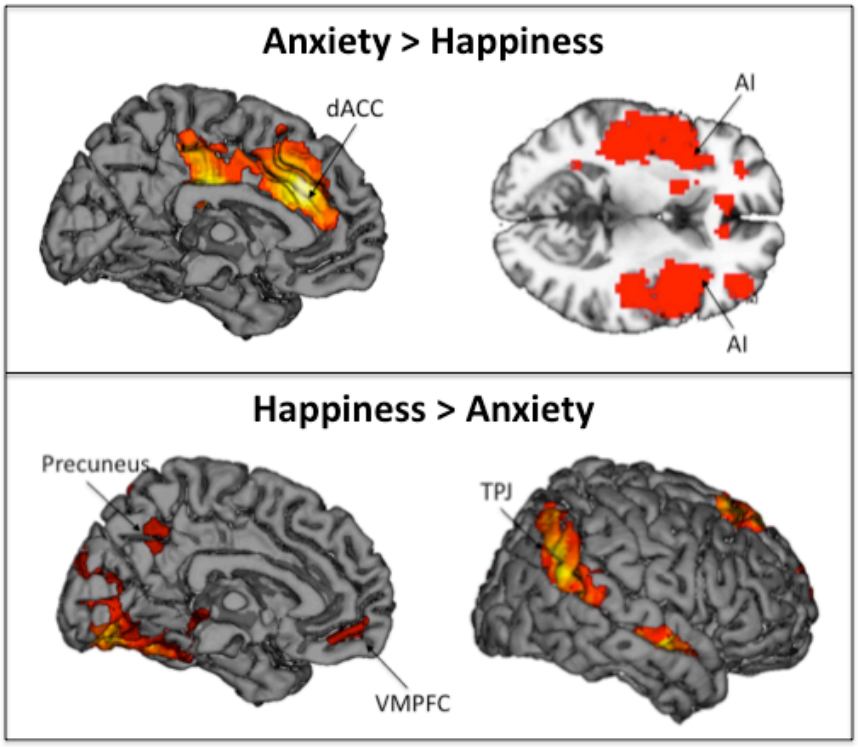
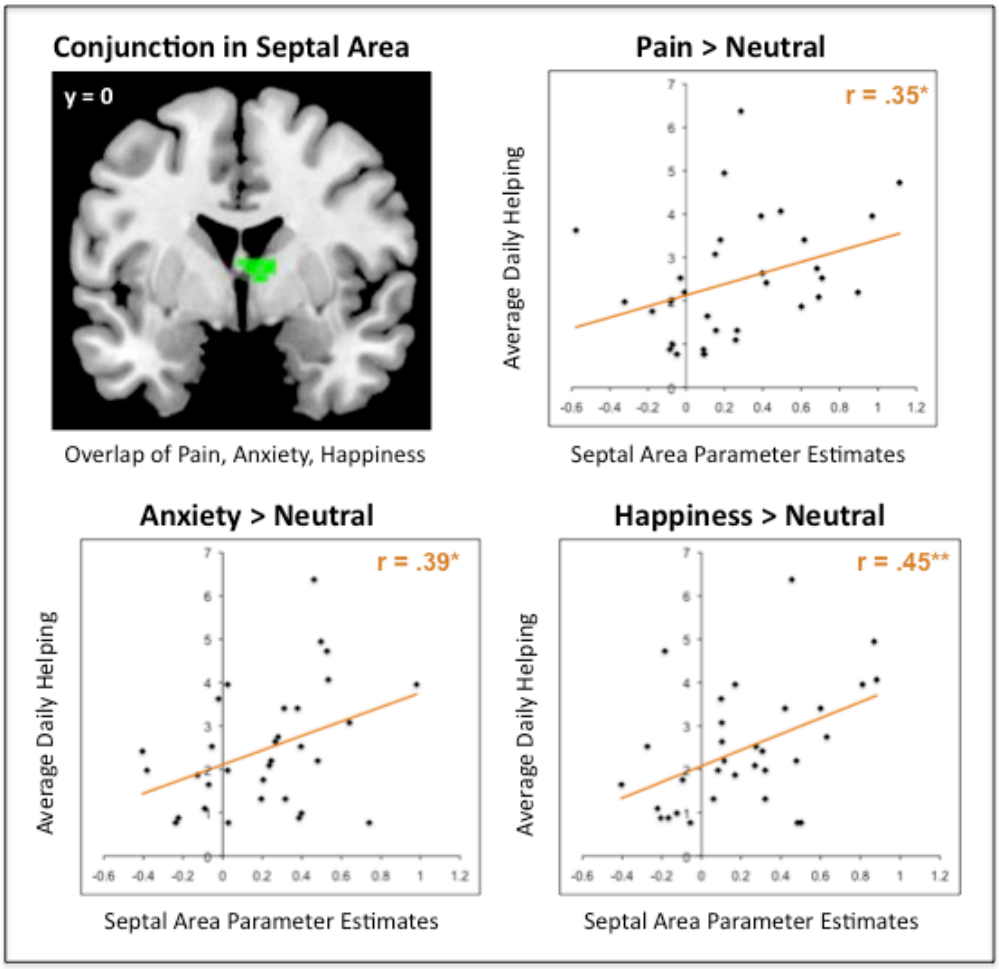

Anxiety > Happiness
dACC
AI
AI
Happiness > Anxiety
Precuneus
TPJ
VMPFC

Figure 2-5.


Conjunction in Septal Area
y = 0
Overlap of Pain, Anxiety, Happiness
Pain > Neutral
r = .35*
Average Daily Helping
Septal Area Parameter Estimates
Anxiety > Neutral
r = .39*
Average Daily Helping
Septal Area Parameter Estimates
Happiness > Neutral
r = .45**
Average Daily Helping
Septal Area Parameter Estimates

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CONCLUSION

These two studies examined the neural and behavioral basis of negative and positive empathy using daily experience sampling and neuroimaging techniques. Study 1 used multiple levels of analysis to illuminate the role of positive empathy in social behaviors, social functioning, and personal well-being. Study 2 provided novel insights into the neural components of empathy and their role in motivating daily helping behavior. To conclude, the key findings from each study are reviewed and interpreted.

Study 1

In this study, the relationship between empathy and several related constructs (i.e. prosocial behavior, aggression, social functioning, and well-being) were examined at several different levels of analysis. In particular, we investigated whether positive empathy increased our ability to predict these social experiences and behaviors over and above what could be predicted with the traditional components of empathy (i.e. PT, EC, PD). Across all levels of analysis, positive empathy showed consistent and strong positive associations with helping behavior, social functioning, and well-being, but a weak and inconsistent relationship with aggression. Critically, these associations between positive empathy and related constructs remained significant after accounting for the effects of other components of empathy.

Findings from Study 1 demonstrate that traditional components of empathy (i.e. negative empathy) and positive empathy jointly predict a large amount of variance in helping behavior, at several levels of analysis. While past research has clearly established that traditional components of empathy (e.g. empathic concern) are associated with helping behavior (Batson, 1995; Batson et al., 1989; Batson, Duncan, Ackerman, Buckley, & Birch, 1981), this study is the first to demonstrate that positive empathy is associated with prosocial behavior. This presents the

interesting possibility that individuals who tend to share others' positive emotions may help others because it is vicariously rewarding. Therefore, positive and negative empathy may motivate different types of prosocial behavior – such as prosocial behavior focused on increasing another's happiness or relieving another's distress, respectively (Batson et al., 1989).

While past research suggests that trait empathy is positively associated with general social functioning (Davis, 1983; Jobe & Williams White, 2007), our findings indicate that positive empathy, in particular, is closely tied to increased feelings of social connection and decreased loneliness. While we cannot determine the causal direction of this relationship, positive empathy may make the empathizer feel socially connected in the moment, as well as facilitating the creation and maintenance of positive social connections over time. Alternatively, a strong sense of social connection may motivate individuals to maintain and strengthen social bonds by frequently engaging in positive empathy.

In addition, positive empathy showed a consistent positive relationship with life satisfaction. One possible explanation for this association is that positive empathy may build personal and relationship resources that lead to a more fulfilling and satisfying life. Alternatively, greater life satisfaction may cause individuals to more readily engage in positive empathy. In contrast, positive empathy showed a weak and inconsistent relationship with antisocial behavior at almost all levels of analysis, failing to support the hypothesis that positive empathy decreases aggression. Finally, our results suggest that including daily empathy measures, in addition to trait empathy measures, increases the accuracy and validity of predictions about daily social experiences and behaviors.

Study 2

In this study, we measured neural responses during empathy for pain, anxiety, and happiness. Analyses aimed to identify neural systems that might (1) support the three components of empathy – perspective-taking, affective congruence, and prosocial motivation – and (2) predict real-world helping behavior. Based on past research, it is unclear whether dACC and AI are specific to empathy for pain experiences or more generally involved in all empathic experiences. The results of Study 2 suggest that dACC and AI are not broadly involved in empathy and may instead be specific to empathy for negative emotions (Lamm, Decety, & Singer, 2011; Masten, Morelli, & Eisenberger, 2011; Meyer et al., 2012). In contrast, activation in VMPFC, a region associated with positive affect, was specific to empathy for positive emotions (Mobbs et al., 2009). Taken together, these findings suggest that empathy does involve affective congruence, activating limbic regions that match the target's positive or negative emotions.

The results of Study 2 also demonstrate that empathy may be evoked through two different neural routes (Lamm et al., 2011; Spunt & Lieberman, 2012). More specifically, empathy for pain activated the MNS more strongly (i.e. IPL, IFG, and posterior SMA), suggesting that the MNS may be more engaged by emotional experiences that are easy to understand. On the other hand, empathy for anxiety and happiness engaged the MZS more strongly (i.e. DMPFC and MPFC), demonstrating that MZS may be recruited when emotional experiences require significant mental effort and social context to understand.

Finally, we found that SA was commonly activated during empathy for pain, anxiety, and happiness and that this functional overlap in SA correlated with daily helping behavior. In animal and human research, the SA activation has been associated with caregiving and prosocial

sentiments (Inagaki & Eisenberger, 2011). Therefore, SA activation during empathy may be a neural maker for prosocial motivation that is related to how helpful individuals are in their daily lives.

Conclusion

Taken together, these studies suggest that positive empathy is neurally and behaviorally distinct from negative empathy. Compared to negative empathy, positive empathy plays a unique and important role in promoting prosocial behavior, social functioning, and well-being. Further, positive empathy uniquely activates neural regions associated with positive affect, while negative empathy selectively recruits neural regions associated with negative affect. On the other hand, positive and negative empathy also show neural and behavioral overlap. At the trait and daily levels of analysis, both positive and negative empathy were positively associated with prosocial behavior. At the neural level, functional overlap between positive and negative empathy was positively related to daily prosocial behavior. Thus, empathy may generally trigger prosocial motivation and increase helping behaviors towards other. By examining the commonalities and differences between positive and negative empathy, the current studies have provided insight into how we understand and share others' various emotions and why we so often feel compelled to help others. Ultimately, this knowledge may suggest novel ways to boost empathy and its beneficial effects on social and personal well-being.

References for Introduction and Conclusion

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