The Empathy Impulse:

A Multinomial Model of Intentional and Unintentional Empathy for Pain

C. Daryl Cameron

Victoria L. Spring

Andrew Todd

Abstract

Empathy for pain is often described as automatic. Here, we used implicit measurement and multinomial modeling to formally quantify unintentional empathy for pain: empathy that occurs despite intentions to the contrary. We developed the Pain Identification Task (PIT), a sequential priming task wherein participants judge painfulness of target experiences while trying to avoid influence of prime experiences. Using multinomial modeling, we distinguished three component processes underlying PIT performance: empathy toward target stimuli (Intentional Empathy), empathy toward prime stimuli (Unintentional Empathy), and bias to judge target stimuli as painful (Response Bias). In Experiment 1, imposing a fast (vs. slow) response deadline uniquely reduced Intentional Empathy. In Experiment 2, inducing imagine-self (vs. imagine-other) perspective-taking uniquely increased Unintentional Empathy. In Experiment 3, Intentional and Unintentional Empathy were stronger toward targets with typical (vs. atypical) pain outcomes, suggesting that outcome information matters and that effects on the PIT are not reducible to affective priming. Typicality of pain outcomes more weakly affected performance on an Object Identification Task—wherein target stimuli were merely categorized rather than judged for painfulness—than on the PIT, suggesting that effects on the latter are not reducible to semantic priming. In Experiment 4, Unintentional Empathy was stronger for participants who engaged in costly donation to cancer charities; but this parameter was also high for those who donated to an objectively worse but socially more popular charity, suggesting that overly high empathy may facilitate maladaptive altruism. Theoretical and practical applications of our modeling approach for understanding variation in empathy are discussed.

Keywords: empathy; pain; process dissociation; multinomial modeling

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In *The Theory of Moral Sentiments*, Adam Smith (1790/2010) captures the everyday experience of empathy: “When we see a stroke aimed and just ready to fall upon the leg or arm of another person ... we feel in it some measure, are hurt by it” (p. 4). Although many people can relate to this response, it likely varies across individuals. One method of assessing variation in empathy is to ask people directly whether they’re empathizing; however, self-reports are notoriously vulnerable to social desirability and limited self-insight (Nisbett & Wilson, 1977) and cannot distinguish intentional and unintentional forms of empathic responding. In the current research, we adopt a different approach by behaviorally assessing how people empathize with others in pain, while modeling component processes to isolate intentional and unintentional forms of empathy that contribute to task performance. By incorporating formal modeling into the study of empathy, the current research can increase theoretical precision and improve prediction of empathic behaviors (cf. Crockett, 2016).

Modern accounts of empathy decompose empathy into multiple components (Zaki & Ochsner, 2012). Experience sharing involves vicariously resonating with others’ experiences; mentalizing involves actively inferring others’ thoughts and intentions; and compassion involves motivation to alleviate others’ suffering (Zaki & Ochsner, 2012). Here, we focus on experience sharing of pain. Though people often appear to vicariously resonate with the pain of others (Lamm et al., 2011), empathy for pain is not obligatory; it is modulated by numerous social factors (for review, see Zaki, 2014). People empathize less with pain of out-group members (Avenanti et al., 2010) and stigmatized others (Decety et al., 2010a). That people appear to

regulate empathy in many cases (Decety et al., 2010b; Lamm et al., 2007) has spurred debate about the contributions of automatic and controlled processes to empathy for pain.

Automatic and Controlled Processes in Empathy

Empathy for pain often appears to arise spontaneously and without instruction, leading to claims that empathy itself is an automatic process, whereas subsequent controlled processing shapes empathic outcomes based on what people *want* to feel. For example, Decety et al. (2010a) claim that empathy involves “bottom-up and top-down information processing components. The former refers to the automatic and covert mimicry component, which drives emotional contagion during interpersonal interactions, and the latter to self-regulation and meta-cognition, which modulates both this automatic resonance system and subsequent pro-social behaviors” (p. 985). Similarly, Hodges and Wegner (1997) contrast automatic and controlled empathy, respectively, as “those processes of empathy that simply happen to people and those that people can consciously and intentionally produce” (p. 311).

Claims about “automatic empathy” often entail verbal descriptions rather than formal models of underlying processes. These rely upon the automatic-controlled distinction much used in social cognition research: between controlled processes that are conscious, intentional, and resource-dependent, and automatic processes that lack these operating conditions (Bargh, 1994). Yet some researchers have criticized the automatic-controlled dichotomy as a lens for understanding social and judgmental processes (e.g., Keren & Schul, 2009; Van Bavel et al., 2012). The different features of automaticity do not always cohere as a natural kind; for example, consciousness, intent, and control can dissociate in cases in which intentionally held goals are pursued unconsciously (for discussion, see Moors & De Houwer, 2006). Verbally described dual process models have been criticized for lacking theoretical precision and testable

predictions (Gawronski & Creighton, 2013). Insofar as empathy research draws upon the automatic-controlled distinction, it is susceptible to the same criticisms.

In the current research, we simultaneously advance theory and method in the study of empathy by using multinomial modeling to distinguish intentional and unintentional forms of empathy that operate simultaneously within the same empathy-eliciting context. Conceptually, we define intentional empathy as experience sharing that is *consistent* with a person's (i.e., the empathizer's) focal intention, whatever that may be. By contrast, we conceptually define unintentional empathy as experience sharing that is *inconsistent* with a person's focal intention. Drawing upon conceptual analysis of intentionality within social cognition (Moors & De Houwer, 2006), we distinguish between weak and strong forms of unintentionality. Whereas weak unintentionality means that a process starts spontaneously without any intention, strong unintentionality means that a process starts even when there is an intention to the contrary. We focus on a strong form of unintentional empathy: empathy that occurs *despite* intentions to the contrary (Moors & De Houwer, 2006). To date, no research has defined unintentional empathy with this conceptual precision nor examined unintentional empathy in this strong form.

A Multinomial Model of Empathy for Pain

To examine the distinction between intentional and unintentional empathy, we use implicit measurement and multinomial modeling. Implicit measures capture spontaneous evaluations while bypassing self-report (for review, see Wentura & Degner, 2010) and are useful for studying empathy given that people may be motivated to report being highly empathic (Paulhus & Reid, 1991). Compared with more intensive measurement techniques such as psychophysiology and neuroimaging, implicit measurement is more efficient, yet like physiology and imaging can still provide an operative assessment of empathy without relying on self-reports.

Despite these potential benefits, implicit measurement is relatively uncommon in the study of empathy. Some past work has used response interference paradigms to assess automatic imitation of bodily movements (for review, see Heyes, 2011), but here we focus on the vicarious sharing of affect. Other work has used interference paradigms to examine how one's own emotions bias empathic judgments (Silani et al., 2013), and how experience sharing can bias theory-of-mind judgments (Kanske et al., 2015), but our approach is the first to dissociate distinct forms of experience sharing operating simultaneously within the same context: intentionally experience sharing with focal targets and unintentionally experience sharing with distracter primes.

To understand variation in empathy for pain, we created a new sequential priming task: the Pain Identification Task (PIT; see Figure 1). This task is modeled on similar sequential priming tasks used in social cognition research, such as the weapon identification task (Payne, 2001). Participants view successive prime and target images, each of which depicts experiences that are painful (hand stuck with needle) or non-painful (hand brushed with Q-tip). The task uses well-validated stimuli from prior research on empathy for pain that people clearly judge as painful or non-painful (Lamm et al., 2007, 2010; Perry et al., 2010). Participants' focal task is to judge the target experience as painful or not while avoiding any influence of the primes (cf. Payne, 2001); responses are coded for accuracy. Thus, participants' intentions are set in direct opposition to prime influence.

The structure of the PIT is similar in many respects to prior empathy for pain studies, which present participants with painful or non-painful experiences and assess responses behaviorally. For instance, Decety et al. (2010b) presented physicians with nearly identical stimuli of hands with needles and Q-tips, interposing binary pain judgments to ensure adequate

attention to stimuli. As in that work, we expected that participants in our studies would immediately resonate with experiences depicted in primes. The PIT differs from past approaches in presenting pairs of experiences to resonate with, some of which participants are instructed to share (targets, the referent of intentional empathy), others of which they are not (primes, the referent of unintentional empathy). In these past approaches, experience sharing is indicated by the degree to which brain networks associated with feeling pain oneself are activated when viewing the pain of others (Lamm et al., 2011). In the current approach, we do not assess the degree to which participants are experiencing the same level of pain as what they are viewing. Rather, unintentional experience sharing with primes is indicated by the degree to which participants exhibit a systematic pattern of mistakes in their pain judgments about target experiences. The inference from this task design that experience sharing is responsive to primes assumes no more—and may assume less—than neuroscientific approaches to assessing empathy for pain, given that in the current approach there is not a need to draw reverse inferences that a particular brain network corresponds to a particular psychological function.

We expected a within-subjects priming effect on pain judgments: Participants should make less accurate judgments of target experiences when the prime experiences are incongruent with the targets. For example, participants who see a painful prime of a hand being stuck with a needle should immediately, and counter to their intentions, resonate with that experience. Although it might seem more theoretically interesting to focus on variation in priming from pain primes, we stipulate that primes capture two ends of a continuum of pain, from extremely high pain (needle) to extremely low pain (Q-tip), as normed in prior work on empathy for pain. If participants see a needle prime, the shared experience should bias their target judgments toward “pain”; but if participants see a Q-tip, the shared experience should bias target judgments toward

“not painful.” Participants should resonate both with the painful and non-painful experiences depicted by the primes. Unintentional experience sharing is likely to involve affect that is consistent with the pain content of the prime experience; in this example, seeing a needle stick a hand is likely to elicit vicarious negative affect. Consistent with prior treatments of empathy for pain, we suggest that affect is an important component of experience sharing; for instance, “when confronted with others’ suffering, empathy would refer to sharing the suffering and hence be associated with negative affect” (Kanske et al., 2016). Unintentionally experience sharing with primes should carry over to influence target judgments. That is, if the target experience is non-painful and thus incongruent, as with a hand being brushed with a Q-tip, then unintentionally experience sharing with a pain prime may lead to a mistaken judgment that the target experience is painful, and vice versa.

Many uses of implicit measures would equate a performance bias such as this with the core construct of interest. This task dissociation approach equates performance on a task with a single underlying process, and so the within-subjects priming effect on the PIT described above might be taken as evidence of “implicit empathy.” However, many kinds of processes can contribute to a single measure, and formal modeling is advantageous in rigorously separating out these relative influences rather than assuming process purity of a particular measure. As one kind of formal model, multinomial models make *a priori* stipulations about how underlying component processes interact to shape behavioral outcomes on a task (Batchelder & Riefer, 1999); thus, behavior can be used to estimate the probability of each process operating (Payne & Bishara, 2009). Prominent examples of this approach include process dissociation (Jacoby, 1991) and the Quadruple Process Model (Conrey et al., 2005), which have been applied to study component processes involved in stereotyping (e.g., Payne, 2001; Todd et al., 2016), self-

regulation (e.g., Ito et al., 2015; Sherman et al., 2008), and judgment and decision-making (e.g., Conway & Gawronski, 2013; Ferreira et al., 2006). However, to date no work has used multinomial modeling to examine empathy.

Our multinomial model stipulates *a priori* three processes that drive judgments on the Pain Identification Task (Figure 2; the Appendix has model equations):

- **Intentional Empathy** is the ability to judge accurately whether target experiences are painful, with probability IE. This operational definition of Intentional Empathy satisfies the conceptual definition of intentional empathy described above: It is experience sharing that is *consistent* with a person's (i.e., an empathizer's) focal intention, which in this task context is to judge the target experiences' painfulness. To the degree that people intentionally empathize with target experiences, they should make accurate judgments about the painfulness depicted in such experiences. In other words, if a person is intentionally resonating with pain depicted in a target image, then she should be more likely to accurately judge that experience as painful. Intentional Empathy is similar to the Control parameter in process dissociation models (Payne, 2001).
- **Unintentional Empathy** is the tendency to judge painfulness of target experiences in a prime-consistent manner, with conditional probability $UE \times (1 - IE)$. This operational definition of Unintentional Empathy satisfies the conceptual definition of unintentional empathy described above: It is experience sharing that is *inconsistent* with a person's focal intention to judge target experiences while avoiding prime influence. Unintentionally empathizing with primes should increase responsiveness to others' pain, which should influence subsequent pain

judgments of target experiences. In other words, if a person is resonating with pain depicted in a prime image of a needle piercing a hand, then he should be more likely to judge the following target experience as “painful.” Similarly, if a person is resonating with non-pain depicted in a prime image of a Q-tip brushing a hand, then he should be more likely to judge the following target experience as “non-painful.” Thus, we are inferring the integral strength of experience sharing with prime content, based upon incidental influences on the pain judgments of target experiences. Unintentional Empathy is similar to the Automatic parameter in process dissociation models (Payne, 2001).

- **Response Bias** is a directional tendency to judge target actions as painful, with conditional probability $(1 - IE) \times (1 - UE) \times RB$, or not painful, with conditional probability $(1 - IE) \times (1 - UE) \times (1 - RB)$. A Response Bias parameter that is significantly above chance (.50) indicates a bias toward judging target actions as “painful”, whereas a Response Bias parameter that is significantly below chance (.50) indicates a bias toward judging target actions as “non-painful.” Critically, we define Response Bias as a non-empathic process: It is simply the tendency to judge target experiences as falling into one category or another without focusing on the experiential content itself. With this third parameter, the multinomial model is identical to a “Control-dominating” process dissociation model with a guessing parameter (Bishara & Payne, 2009).

The multinomial model depicted in Figure 2 and the Appendix specifies how these three processes inter-relate to cause accurate and inaccurate responses in different conditions of the PIT. Accuracy on each trial type can be computed by summing probabilities across branches of

the process tree, and observed frequencies of responses across conditions can then be used to solve for parameter values using maximum likelihood estimation. The estimation procedure iteratively changes parameter values until an optimal fit is reached between observed frequencies and frequencies predicted by the model. Model fit is assessed with a likelihood ratio G^2 statistic, with non-significance indicating model fit, as well as with the effect size w , an r -family statistic with values less than .05 indicating model fit (cf. Clerkin et al., 2014). To examine whether an experimental manipulation influences a process parameter, one can constrain the parameter across conditions to test if doing so significantly reduces model fit.

We chose this multinomial model for two reasons. First, the “Control-dominating” process dissociation model is one of the most well-known formal models in social psychology, and best accounts for data on similarly structured sequential priming tasks used in social cognition research (Bishara & Payne, 2009). It also best reflects our conceptualization of Intentional and Unintentional Empathy: if participants are following task instructions, unintentionally empathizing with the prime should only occur if intentionally empathizing with the target has failed. Second, by including the Response Bias parameter, we can disentangle spontaneous responses to primes (Unintentional Empathy) from directional tendencies to always judge target experiences as painful (Response Bias; Conrey et al., 2005).

Theoretical and Methodological Advantages of a Modeling Approach

The current approach, including the novel implicit measure and multinomial model, provides a theoretical and methodological advance for several reasons. Theoretically, it moves beyond “automatic and controlled empathy” to formally specify two kinds of experience sharing (intentional, unintentional) that can operate simultaneously. As operationalized in the current experiments, unintentional empathy (i.e., *counter-intentional* empathy) is a novel construct

within the science of empathy. By distinguishing intentional and unintentional empathy in this way, the current research opens up new directions for future research, particularly in clarifying how different types of empathy may vary across situations.

Methodologically, our approach advances beyond confounds in self-report trait empathy measures. Rather than rely on self-report, our approach captures empathy through behavioral performance and process modeling. The Unintentional Empathy parameter may be a purer reflection of empathy by comparison to many trait measures. For instance, the Personal Distress scale of the Interpersonal Reactivity Index (Davis, 1983) has been used as a trait measure of experience sharing (e.g., Decety & Yoder, 2015), yet the item content may capture emotion dysregulation rather than vicarious sharing of affective experiences. By contrast, the current task is designed to capture experience sharing through its incidental influence on target judgments: If a person resonates with the experiences depicted in primes (e.g., pain), then she should be more likely to be biased toward judging target experiences as painful. Self-report trait measures also conflate ability to empathize with propensity to empathize (Keysers & Gazzola, 2014), making it difficult to distinguish empathic experience from response correction or other processes unrelated to those of theoretical interest. Across four experiments, we sought to validate the PIT and the multinomial model, by providing evidence for discriminant validity of the process parameters using experimental manipulations.

Experiment 1: Time Pressure Decreases Intentional Empathy

Experiment 1 aimed to test for a within-subjects priming effect in the PIT and to validate the multinomial model. We also tested whether imposing a speeded response deadline reduces Intentional Empathy, but not Unintentional Empathy or Response Bias, which would provide evidence for dissociation of the component processes and suggest that Intentional Empathy has

operating conditions of a controlled process (consistent with prior process dissociation studies; e.g., Conway & Gawronski, 2013; Payne, 2001).

Method

Undergraduates ($N = 108$, 72 women, 36 men) completed the Pain Identification Task.

They received the following instructions:

Each trial of this task will start with a fixation cross, +, that you should focus your eyes on. Then we will show you pairs of images flashed one after the other. Ignore the images that come first. Another image will come second. Your job is to make a quick judgment of whether the second image depicts an experience that is painful or not. Please try to imagine the pain (or non-pain) being experienced as vividly as possible. If the second image depicts an experience that is painful, press the “M” key on the keyboard. If the second image does not depict an experience that is painful, press the “Z” key. Ignore the influence of the first image that comes beforehand. Finally, please respond as fast as possible.

Prime and target stimuli were images of hands being pierced with a needle or brushed with a Q-tip, which are consensually judged as painful and non-painful, respectively (Lamm et al., 2010). There were two sets each of painful and neutral stimuli. Stimulus sets were counterbalanced so that one set of painful/neutral images was used as primes and the other set as targets. Prime-target pairs were presented randomly, and image lists were counterbalanced. Each trial began with a fixation cross in the center of the screen (200 ms), followed by a prime image (150 ms), then a blank screen (75 ms), and finally a target image (on screen until participants responded). If participants’ responses exceeded the deadline (400 ms or 800 ms, depending on between-subjects condition), they saw a red “X” and were urged to “Please respond faster!” The task contained two blocks with 15 trials per prime-target combination, for a total of 120 experimental trials. Four practice trials preceded the experimental trials.

Results

Computer malfunctions resulted in PIT data loss for two participants. Tables 1 and 2 display error rates and parameter estimates by condition.

Error rates. As predicted, a 2 (Deadline: 400 ms, 800 ms) $\times$ 2 (Prime: painful, neutral) $\times$ 2 (Target: painful, neutral) mixed ANOVA revealed that participants made more errors judging neutral targets after painful primes and more errors judging painful targets after neutral primes, producing a significant Prime $\times$ Target interaction, $F(1, 104) = 82.56, p < .001, \eta_p^2 = .44$. Also as expected, Deadline moderated this effect, $F(1, 104) = 22.26, p < .001, \eta_p^2 = .18$, which was stronger in the 400-ms-deadline condition, $F(1, 54) = 65.09, p < .001, \eta_p^2 = .55$, than in the 800-ms-deadline condition, $F(1, 50) = 21.03, p < .001, \eta_p^2 = .30$.

Multinomial model. Next, we conducted modeling analyses using MultiTree (Moshagen, 2010). Our general approach was to estimate Intentional Empathy, Unintentional Empathy (constrained across pain-prime and neutral-prime conditions), and Response Bias parameters for each deadline condition and compare these estimates against zero (or chance [.50], for Response Bias) and across conditions. We tested our hypotheses by examining change in model fit (ΔG^2) when imposing such constraints; we also report effect size w (from the r -family of effect sizes), with $w \leq .05$ indicating acceptable fit (Clerkin et al., 2014). This model fit the data, $G^2(2) = 4.10, p = .129, w = .04$. As predicted, Intentional Empathy was lower in the 400-ms-deadline than in the 800-ms-deadline condition, suggesting that Intentional Empathy has operating conditions typically ascribed to controlled processing (Payne, 2001; Sherman et al., 2008). Unexpectedly, imposing a fast deadline also increased Response Bias to always judge target experiences as painful. It is possible that in having less time to make a judgment, participants felt that the safest option to be accurate was to judge target experiences as painful.

Experiment 2: Self-Focused Perspective-Taking Increases Unintentional Empathy

Experiment 1 provided preliminary support for our multinomial model and validated the operating conditions of Intentional Empathy with a deadline manipulation. Experiment 2 aimed to validate Unintentional Empathy with a perspective-taking manipulation. Prior work finds that whereas imagine-other instructions primarily elicit compassion, imagine-self instructions elicit both compassion and empathic distress (Batson et al., 1997, 2003). Imagine-self instructions cause people to rate others' suffering as more intensely painful (Jackson et al., 2006), and to experience more empathic distress themselves (Lamm et al., 2007); additionally, such instructions increase activation of brain networks previously associated with experience sharing (Jackson et al., 2006) and affective responses to pain (Lamm et al., 2007). As put by Lamm and colleagues (2007): "We thus suggest that the self-perspective results in the evaluation of the affective, autonomic, and motivational consequences obtained from the imagination of a painful experience, in line with the evocation of personal distress" (p. 55).

While completing the PIT, participants imagined either the feelings of the people in the photos (imagine-other) or how they themselves would feel in that situation (imagine-self). In light of prior work, we expected that imagine-self perspective-taking would increase unintentional empathy toward primes, increasing their biasing effect on target judgments (i.e., the enhanced Prime $\times$ Target interaction). We predicted that the specific Prime $\times$ Target interaction—where error rates increase when the content of prime and target experiences is incongruent—would increase under imagine-self (vs. imagine-other) instructions, because the potency of the primes to bias target judgments would be increased. This difference in the Prime $\times$ Target interaction across perspective-taking conditions should be accounted for, in terms of the modeling analysis, by an increase in Unintentional Empathy in the imagine-self condition.

Method

Undergraduates ($N = 103$, 79 women, 23 men, 1 unreported) first completed a PIT that was identical to the one in Experiment 1, except there was only one block of 60 experimental trials, and the deadline was held constant at 400 ms. In the *imagine-self* condition, PIT instructions read: “Try to imagine that you are the person in the picture, and how YOU would feel. Make your judgment based upon how YOU would feel in this situation.” In the *imagine-other* condition, PIT instructions read: “Try to imagine the person in the picture, and how THAT PERSON would feel. Make your judgment based upon how you imagine THAT PERSON feels in this situation.” Response key mappings were also described differently across conditions: “If the second image depicts an experience you [that person] would find painful, press the key labeled ‘painful’ on the keyboard. If the second image depicts an experience you [that person] would find non-painful, press the ‘non-painful’ key.”

Results

Computer malfunctions resulted in data loss for one participant. Tables 3 and 4 display error rates and parameter estimates by condition.

Error rates. As in Experiment 1, a 2 (Perspective-Taking) $\times$ 2 (Prime) $\times$ 2 (Target) mixed ANOVA revealed a significant Prime $\times$ Target interaction, $F(1, 100) = 91.07, p < .001, \eta_p^2 = .48$. Critically, and in line with our predictions, this effect was moderated by Perspective-Taking, $F(1, 100) = 6.58, p = .012, \eta_p^2 = .06$, such that the Prime $\times$ Target interaction was stronger in the imagine-self condition, $F(1, 49) = 68.95, p < .001, \eta_p^2 = .59$, than in the imagine-other condition, $F(1, 51) = 25.90, p < .001, \eta_p^2 = .34$. Overall, participants made more errors judging neutral targets after painful than neutral primes and vice versa when judging painful targets; however, this effect was stronger in the imagine-self than in the imagine-other condition.

It might be argued that imagine-self instructions could lead to more errors on the PIT because of egocentrism; i.e., participants imagining themselves in the depicted experiences might make mistaken judgments because they disagree with whether they would feel pain. Were this the case, then we would expect a main effect whereby participants in the imagine-self condition make more egocentric errors, regardless of prime and target, when asked to project themselves into the experiences in the task. However, there was not a main effect of Perspective-Taking, $F(1, 100) = .02, p = .903, \eta_p^2 = .00$, ruling out egocentric errors as an explanation of the effect. Instead, as noted above, imagine-self instructions caused the particular Prime $\times$ Target interaction—increased errors when prime and target experiences were incongruent in terms of pain—to strengthen, suggesting increased empathic responsiveness to primes.

Multinomial model. To clarify whether imagine-self instructions increased the priming effect via increases in Unintentional Empathy, we estimated Intentional Empathy, Unintentional Empathy, and Response Bias parameters for each perspective-taking condition. This model fit the data, $G^2(2) = .37, p = .833, w = .02$. As expected, and consistent with prior work suggesting that imagine-self instructions increase spontaneous experience sharing (e.g., Lamm et al., 2007), Unintentional Empathy was stronger in the imagine-self than in the imagine-other condition.

Importantly, the perspective-taking manipulation did not influence Intentional Empathy or Guessing. It might be argued that the imagine-self manipulation is a kind of intentional empathy, inasmuch as participants are being directed to empathize in a particular way. However, instructions to vividly imagine self versus other are orthogonal to Intentional Empathy, which is operationalized as accurately judging target experiences. Were imagine-self vs. imagine-other perspective-taking simply a manipulation of Intentional Empathy, then Intentional Empathy should be higher in the imagine-self condition, which is not what was observed.

Experiment 3: The Effect is Not Reducible to Affective or Semantic Priming

Experiments 1 and 2 revealed that theoretically relevant experimental manipulations influenced process parameters in opposing directions: Imposing a fast response deadline reduced Intentional Empathy but did not influence Unintentional Empathy, whereas self-focused perspective-taking increased Unintentional Empathy but not Intentional Empathy. In Experiment 3, we examined the discriminant validity of the PIT by testing two alternative explanations of task performance: affective priming and semantic priming. Establishing the discriminant validity of empathy for pain is important, given that component processes typically associated with experience sharing of pain—such as negative affect and semantic knowledge about painful situations—are also involved in non-empathic judgments (Zaki et al., 2016).

First, it may be that people are responding to the affective content of negative stimuli (needles), and this negative affect is carrying over to influence pain judgments of target experiences, even in the absence of empathizing. We suggest, first, that affect is a critical component of empathy for pain (Tusche et al., 2016): Because experience sharing involves vicarious resonance with the affective states of others, it will be difficult to distinguish empathy priming from affective priming in practice. We stipulate that people unintentionally share the experience of the prime stimuli, and the resulting experience influences target judgment; if the prime depicts pain, then this is likely to involve vicarious negative affect, because pain tends to be experienced as negative. In everyday life, it is likely that the affective content of stimuli (i.e., needles are usually bad) and the outcomes to which they are typically connected (i.e., needles usually cause pain) converge, making it difficult to distinguish empathy from affect. Nevertheless, in the current experiment, we aimed to create a dissociation between empathy for painful outcomes and negative affect in response to stimuli.

Prior research has established that people experience negative affect in response to typically harmful actions, even if the actions do not result in harmful outcomes (Cushman et al., 2012; Miller et al., 2014). To examine whether PIT effects are reducible to affective priming over negative versus neutral stimuli, we manipulated whether target experiences were stipulated to be painful or not (using a manipulation from Lamm et al., 2010). Participants made judgments about normal patients (who were stipulated to have typical pain outcomes from needles and Q-tips) and neurological patients (who were stipulated to feel no pain from needles and to feel pain from Q-tips). If the PIT merely captures affective priming, then patient outcomes should not influence task performance; rather, negative affect attached to prime stimuli should influence target judgments regardless of what the actual pain outcomes are stipulated to be. If the PIT captures empathy, as we suggest, then patient outcomes should influence task performance; because empathizing with dissimilar targets can be difficult (Lamm et al., 2010), priming effects on the PIT should be reduced for neurological patients. In other words, if outcome information influences PIT performance, then this would reveal that negative affective priming over the stimuli themselves cannot fully account for the effect.

Second, it may be that people have accessible knowledge about needles as painful, and this semantic content is carrying over to influence pain judgments of target experiences even in the absence of empathizing. In other words, does the priming effect on the PIT merely reflect domain-general response incompatibility due to semantic priming, and not empathy in particular? To examine this possibility, we created an Object Identification Task (OIT) in which participants categorized target objects as needles or Q-tips, with needle and Q-tip primes coming beforehand. As with the PIT and consistent with prior demonstrations of semantic priming, we expected a response incompatibility effect: Participants should make more errors identifying

target objects after incongruent prime objects (e.g., more errors identifying a needle after Q-tip primes than after needle primes). To establish discriminant validity that the PIT, but not the OIT, captures empathy, we also included the patient type manipulation in the OIT. If the PIT, like the OIT, is only capturing accessible semantic content, then patient type should not matter for performance on either task; in both cases, accessible knowledge about needles should facilitate target judgments. In other words, if accessible knowledge explains the priming effects, then we should not observe selective effects of empathy-relevant manipulations on the PIT.

Method

Undergraduates ($N = 151$, 66 women, 72 men, 12 unreported) first completed a PIT that was similar to those used in Experiments 1 and 2. They learned that the prime and target images came from two different groups of patients: *normal* patients, who have tinnitus (a condition that causes ringing in the ears) but who otherwise experience pain typically, and *neurological* patients, who have a condition in which they experience pain when being touched by soft objects (e.g., Q-tips) and no pain when being pierced by needles. To increase the salience of this manipulation, each trial began with an image of the person whose hand would be shown later in the trial, with patient type labeled underneath. This face image remained on screen until participants pressed the spacebar, after which the prime and target stimuli appeared with identical timing as in Experiments 1 and 2. Figure 3 displays a sample trial of this adapted version of the PIT. Participants were told: “Each trial of this task will start with an image that is the cue for the rest of the trial to begin. This image depicts the person whose hands are shown later in the trial. Click the Spacebar to progress past this image.” After receiving the standard task instructions, participants received the following instructions:

You will see images of two types of people presented in this task. Some of the people whose hands you will see are Normal Patients, who have tinnitus, a normal condition that causes ringing

sensations in the ears. Normal patients experience pain when being pricked by a needle and experience no pain when being touched by a soft object (such as a Q-tip). Other people whose hands you will see are Neurological Patients, who have dysalgia, a neurological condition that causes changed pain experiences. Neurological patients experience pain when being touched by a soft object (such as a Q-tip) and experience no pain when being pricked by a needle. Before each set of trials, we will tell you which kind of patient it is whose hands are shown in the image.

While doing the task, please vividly imagine the pain the person depicted might feel in response to having his or her hand touched with a Q-tip or hand pricked with a needle. Remember, you are judging whether the final image depicts an experience that is painful or not.

Participants completed counterbalanced neurological-patient and normal-patient blocks of trials. Within each patient block, there were four face exemplars (two female, two male), with eight trials per prime-target combination per face, resulting in 32 trials of each prime-target combination within each patient block. To uphold the cover story, we used different sets of faces in each block and matched the hand stimuli to be the same gender as the face exemplar.

Next, participants completed the OIT. As in the PIT, participants saw two images in quick succession and tried to ignore the first image. They also saw the face image with patient type at the beginning of each trial. This time, however, they judged whether the target image depicted a needle or Q-tip. Participants received the following instructions:

First you will see an image that is the cue for the rest of the trial to begin. This image depicts the person whose hands are shown later in the trial. Remember that some of these people are Normal Patients and some are Neurological Patients. Click the Spacebar to progress past this image.

Then you will see pairs of images flashed on-screen. This time, you will be judging whether the final image depicts a needle or a q-tip. Press the key labeled “needle” if the final image depicts a needle, and press the key labeled “q-tip” if the final image depicts a q-tip. Remember to ignore the preceding images. Take a moment now to look down at the keyboard and see which keys are

labeled “needle” and “q-tip,” as they are different from the ones you were using before.

Remember to ignore the influence of the images that come beforehand. Finally, please respond as fast as possible.

All other task features were identical to the PIT in previous experiments.

Results

Computer malfunctions resulted in PIT data loss for seven participants and OIT data loss for 13 participants. Tables 5 and 6 display error rates and parameter estimates by condition.

Error rates. Accuracy was coded relative to patient type: For normal patients, judging a needle target as painful and Q-tip target as non-painful was coded as accurate, whereas for neurological patients, judging a needle target as non-painful and a Q-tip target as painful was coded as accurate. To facilitate comparison across the PIT and OIT, we analyze and discuss the 2×2 design of the PIT in terms of the stimuli (i.e., needle vs. Q-tip) rather than in terms of the pain content (i.e., painful vs. non-painful) as we have in previous experiments, because in the current experiment different patient groups are stipulated to find different stimuli painful or non-painful. For instance, for normal patients, needle/Q-tip trials are painful/non-painful trials respectively, and for neurological patients, needle/Q-tip trials are non-painful/painful trials respectively. This change does not influence interpretation of the expected Patient Type $\times$ Prime $\times$ Target interaction; although pain and non-pain are attached to different prime and target stimuli for neurological patients, the critical test is whether the Prime $\times$ Target cross-over interaction is reduced for this group. This change also does not influence modeling, because Unintentional Empathy is constrained to be constant across prime conditions, and so Unintentional Empathy captures empathy in response to both painful and non-painful primes regardless of which prime stimuli those happen to be.

A 2 (Patient Type) $\times$ 2 (Prime) $\times$ 2 (Target) repeated-measures ANOVA on the PIT revealed the expected Prime $\times$ Target interaction, $F(1, 143) = 122.87, p < .001, \eta_p^2 = .46$, which was moderated by Patient Type, $F(1, 143) = 40.85, p < .001, \eta_p^2 = .22$. As in previous experiments, the Prime $\times$ Target interaction was strong for normal patients, $F(1, 143) = 175.90, p < .001, \eta_p^2 = .55$, with participants making more errors judging the painfulness of Q-tip (neutral) targets after needle (Q-tip) than Q-tip (neutral) primes, and vice versa when judging needle (painful) targets. The Prime $\times$ Target interaction was present but substantially weaker for neurological patients, $F(1, 143) = 4.88, p = .029, \eta_p^2 = .03$, with participants making marginally more errors judging the painfulness of needle (neutral) targets after Q-tip (painful) than needle (neutral) primes, and significantly more errors judging the painfulness of Q-tip (painful) targets after needle (neutral) than Q-tip (painful primes). These results suggest that performance on the PIT is not reducible to affective priming: Were the effect primarily due to affective responses to prime and target stimuli, then information about patient outcomes—i.e., the referent of empathy—should not influence results in this manner.

An identical ANOVA on the OIT also revealed a Prime $\times$ Target interaction, $F(1, 136) = 135.20, p < .001, \eta_p^2 = .50$. Participants made more errors judging Q-tips after needle than Q-tip primes and vice versa when judging needles; however, as expected, Patient Type did not moderate this effect, $F(1, 136) = 1.12, p = .292, \eta_p^2 = .01$. Thus, whereas the manipulation of patient pain outcomes moderated performance on the PIT, it did not moderate performance on the OIT, suggesting that effects on the PIT are not reducible to semantic priming. Were the results reducible to semantic priming, then the patient type manipulation should not have had any influence on either task.

Multinomial models. For the PIT, we estimated Intentional Empathy, Unintentional Empathy, and Response Bias for each patient condition. The only difference from previous studies is that the equations differed slightly for the neurological patient condition: In this condition, Response Bias to judge target experiences as painful leads to inaccurate responses on needle-target trials, and accurate responses on Q-tip-target trials. This model fit the data, $G^2(2) = .18, p = .916, w = .00$. As expected, Unintentional Empathy was weaker for neurological patients than for normal patients, which is to be expected given prior research that people experience less empathy for dissimilar targets (Lamm et al., 2007). Intentional Empathy was also weaker for neurological patients. This result likely indicates that it was more difficult for participants to accurately judge target experiences that have atypical mappings (i.e., judging needles as non-painful). Response Bias did not differ across patient conditions.

For the OIT, the model was slightly different because the conceptual meaning of the underlying processes changes across tasks. Unlike for the PIT, for the OIT equations did not differ across the patient conditions because in this case, accuracy in judging target objects is not relativized to patient outcomes, and so Response Bias to judge target objects directionally should lead to accurate/inaccurate outcomes in the same manner regardless of patient condition. Intentional Empathy was replaced with Discriminability: the ability to accurately categorize target objects as needles or Q-tips. Unintentional Empathy was replaced with Accessibility Bias: prime-consistent knowledge activation. This process is not empathy-related, but rather refers to semantic content about needles and Q-tips activated by primes. The model fit the data, $G^2(2) = 4.42, p = .110, w = .03$. Discriminability and Accessibility Bias were weaker for neurological than for normal patients, but these effects were much smaller relative to the analogous effects of patient type on Intentional Empathy and Unintentional Empathy on the PIT.

In summary, patients with atypical (vs. typical) pain outcomes elicited less Intentional Empathy and Unintentional Empathy on the PIT. This result suggests that these parameters are not reducible to negative affect: Were this the case, then affect should be the same across patient conditions, because the affect is in response to stimuli, rather than being sensitive to outcomes. The patient outcome manipulation did also influence processes on the OIT, with Discrimination and Accessibility Bias reduced for the neurological patient, but these effects were substantially weaker than analogous effects on the PIT. In summary, if the PIT were only capturing affective or semantic priming, then patient outcomes should not matter and should not produce stronger effects on the PIT than on the OIT.

Experiment 4: Unintentional Empathy Associates with Donation Behavior

Experiments 1-3 validated the Pain Identification Task and multinomial model: The parameters are influenced in distinct ways by relevant processing manipulations, and Unintentional Empathy is not reducible to affective or semantic priming. In Experiment 4, we tested whether these process parameters converge with actual pro-social behavior, and in so doing, tested a novel theoretical claim about empathy. Participants were given the opportunity to donate money to different cancer charities. We predicted that participants who donated (vs. not) would show increased Unintentional Empathy.

In addition to examining the presence/absence of pro-social behavior, we also examined which charity participants donated to. Of the two charities presented to participants, one was objectively better at achieving its outcomes but less well-known, whereas the other was objectively worse but more popular. If sufficiently high, empathy might lead to “pathological” or maladaptive altruism: pro-social behavior that is ineffective or even counter-productive

(Oakley, 2013). One study found that a physiological response linked to pro-sociality (i.e., vagal nerve activity), if sufficiently high, can interfere with pro-social behavior (Kogan et al., 2014).

Here, we focus on the more proximal psychological process of empathy and, for the first time, examine the connection between multiple forms of empathy (intentional, unintentional) and maladaptive altruism. We predicted that Unintentional Empathy would be high for participants who donated to the objectively worse charity, relative to non-donors and to participants who donated to the objectively better charity. In this experiment, we also manipulated response deadline to replicate Experiment 1, and to test whether relationships between Unintentional Empathy and donation behavior would be similar across the deadline manipulation, which should have not a substantial influence.

Method

Undergraduates ($N = 255$, 169 women, 84 men, 2 unreported) completed a PIT that was nearly identical to the PIT used in Experiment 1, except that the line “Please try to imagine the pain (or non-pain) being experienced as vividly as possible” was removed from instructions. As in Experiment 1, participants were randomly assigned to a 400 ms or 800 ms deadline condition. Participants completed two blocks of 60 trials each, with 30 trials per prime-target combination. Additionally, key mappings were altered so that the painful key was assigned to Z, and the non-painful key was assigned to M. All other task features were identical to previous experiments. After the PIT, participants read:

Breast cancer is a malignant tumor (cancer) that starts in the breasts and can spread (metastasize) throughout the entire body. In 2015, over 300,000 women will be diagnosed with breast cancer. About 1 in 3 (33%) cases of breast cancer are in women younger than 55, and the average woman's lifetime risk of developing breast cancer is 1 in 8. Doctors recommend that women start having regular breast exams once every three years starting at age 20, and that

women in their 20s perform a monthly breast self-exam. Breast cancer is most easily treated if it is caught early.

On the next screen, participants read:

In addition to the credit you will receive on SONA, you will also receive \$5 additional compensation for completing this experiment. You will be given this compensation during debriefing, at which point you will have the option of either keeping the money or donating it to one of two breast cancer charities. If you donate to the Susan G Komen Foundation, you will also receive a pink ribbon for your support. Press "Continue" to learn more.

Participants then viewed side-by-side information about the Breast Cancer Research Foundation and the Susan G. Komen Foundation. Each organization was displayed with its official name and logo, along with an “Expenses Breakdown” drawn from Charity Navigator (<http://www.charitynavigator.org/>) that split expenses for each organization into three categories: Program, Administrative, and Fundraising. At the bottom of the page, participants read: “Charity Navigator is an organization which assesses the distribution of funds raised by tax-exempt nonprofit organizations to determine how well they adhere to their stated goals.” Beneath this description, they saw actual Charity Navigator Financial Ratings for Susan G. Komen (2 out of 4 stars) and for Breast Cancer Research Foundation (4 out of 4 stars). After viewing this information, participants were asked “Which charity is the objectively better charity?” and made a binary judgment.

At the end of the experiment, participants were told that they could donate their additional \$5 compensation, which was presented to them in an envelope of five \$1 bills. In a separate room, they viewed the same breast cancer charity information from earlier, along with two buckets corresponding to the charities. The research assistant reminded participants that they could make a donation to one of the two breast cancer charities they learned about during

the study, and that if they donated to Susan G. Komen they would also receive a breast cancer awareness ribbon. Participants then proceeded to the donation room alone and had the opportunity to place any donation in one of the two buckets. During debriefing, all donations were returned to participants.

Results

Computer malfunctions resulted in PIT data loss for one participant. We excluded PIT data for one additional participant with overall accuracy more than 3 standard deviations below the mean. Tables 7 and 8 display error rates and parameter estimates.

Charity ratings and donation behavior. Seven participants did not provide a charity rating. The majority of participants ($N = 176$, 69.6%) rated the Breast Cancer Research Foundation as a better charity than the Susan G. Komen Foundation, one-sample $t(247) = 7.43$, $p < .001$, mean difference from chance = .21, 95% CI: [.16, .27]. For donation behavior, we excluded data for 5 participants who did not follow task instructions and instead split the \$5 compensation between the two charities. Most participants donated either nothing (\$0, $N = 29$) or the full amount (\$5, $N = 204$), but a small minority donated an amount less than \$5 ($N = 17$). For the current analyses, we collapsed all participants who donated at all into a single category. Of the 221 participants who donated at all, 136 participants donated to the Breast Cancer Research Foundation, and 85 participants donated to the Susan G. Komen Foundation.

Error rates. As expected, a 2 (Deadline) $\times$ 2 (Prime) $\times$ 2 (Target) mixed ANOVA revealed that participants made more errors judging neutral targets after painful primes and more errors judging painful targets after neutral primes, producing a significant Prime $\times$ Target interaction, $F(1, 251) = 263.89$, $p < .001$, $\eta_p^2 = .51$. Replicating Experiment 1, Deadline moderated this effect, $F(1, 251) = 37.01$, $p < .001$, $\eta_p^2 = .13$, which was stronger in the 400-ms-

deadline condition, $F(1, 127) = 253.24, p < .001, \eta_p^2 = .67$, than in the 800-ms-deadline condition, $F(1, 124) = 50.82, p < .001, \eta_p^2 = .29$.

Multinomial model. We estimated Intentional Empathy, Unintentional Empathy, and Response Bias parameters separately for six groups: within each deadline condition, participants who did not donate, who donated to the Breast Cancer Research Foundation (BCRF), and who donated to the Susan G. Komen Foundation (SGK). This model fit the data, $G^2(6) = 8.72, p = .190, w = .03$. Replicating Experiment 1, Intentional Empathy parameters were reduced under the 400 ms (vs. 800 ms) deadline.

Generally, Unintentional Empathy was highest among SGK donors, but the specific patterns differed across deadline condition. In the 400-ms-deadline condition, Unintentional Empathy was higher for donors than for non-donors, regardless of charity choice ($ps < .035$), but Unintentional Empathy was the same for SGK and BCRF donors. In the 800-ms-deadline condition, Unintentional Empathy for SGK donors was higher compared to BCRF donors ($p = .011$) and marginally higher compared to non-donors ($p = .087$). These results generally support our hypothesis that Unintentional Empathy would be high among donors to the lower-rated charity. Unexpectedly, there was not a difference in Unintentional Empathy between SGK and BCRF donors in the short deadline condition; however, in this group it is still noteworthy that Unintentional Empathy was high for both groups compared to non-donors, suggesting that this process can facilitate both ineffective and effective forms of altruism.

Intentional Empathy also differed across donor groups, but this depended on deadline condition. In the 400-ms-deadline condition, Intentional Empathy was higher for donors than for non-donors, regardless of charity choice ($ps < .020$). In the 800-ms-deadline condition, there were no differences in Intentional Empathy across donor groups. This moderation by deadline

was not expected, and given that the key focus was on Unintentional Empathy across donor groups, we do not discuss this finding further.

In summary, the current study connects the component processes underpinning the PIT to real-world charitable behavior. Unintentional Empathy was associated with increased costly prosocial behavior: It was higher among donors than non-donors. Among participants who made a donation, Unintentional Empathy also was associated with maladaptive altruism, being high among those who contributed to the less effective but more socially popular charity (Susan G. Komen Foundation). In the long deadline condition, Unintentional Empathy was uniquely highest among SGK donors; in the short deadline condition, Unintentional Empathy was comparably high among SGK and BCRF donors. Nevertheless, the important result is that, at overly high levels, Unintentional Empathy was associated with potentially maladaptive forms of altruistic behavior.

Our aim was to present one charity as the objectively better option, but then provide a second charity that people would be tempted toward despite its being objectively worse. In this experiment, the Susan G. Komen charity was not only worse, but also more popular and involved receiving a physical token; thus, both prestige motives and popularity could have motivated donation to this charity. We aimed to provide an over-determined set of reasons to be tempted to choose Susan G. Komen despite its being objectively worse. Future research could usefully dissociate how different sources of motivation (i.e., receiving a token, increasing reputation) interact with Unintentional Empathy and Intentional Empathy to drive maladaptive altruism.

General Discussion

People commonly experience others' pain as if it were their own, yet this empathic tendency varies across individuals. Here, we developed a novel Pain Identification Task to

capture this variability and a multinomial model to distinguish intentional and unintentional forms of empathy operating simultaneously within the same context. This model decomposes three processes: Intentional Empathy (accurate judgment of painfulness of target experiences), Unintentional Empathy (tendency to judge target experiences in a prime-consistent manner, indicating empathic resonance with prime experiences), and Response Bias (directional tendency to always judge target experiences as “painful” or “non-painful”). We consistently found reduced accuracy in judging pain-relevant target experiences when preceding primes were incongruent. The model successfully accounted for task performance, and model parameters were influenced in distinct ways by relevant process manipulations: Intentional Empathy was reduced under a speeded response deadline, and Unintentional Empathy was stronger after imagine-self perspective-taking and for target persons who experience pain normally.

One alternative explanation is that PIT priming is reducible to common knowledge of needles as painful, or semantic priming. Experiment 3 included an Object Identification Task (OIT) in which the focal judgment was merely to identify the target objects themselves rather than the outcomes experienced by the target persons. Although there was evidence of priming in the OIT, patient outcomes did not influence performance or process parameters to the same degree as in the PIT. Another alternative explanation is that PIT priming is reducible to affective responses to prime and target stimuli, or affective priming. Conceptually, experience sharing of pain is likely to involve negative affect, given that most people find pain to be negative. However, in Experiment 3, we dissociated between empathy and negative affect using an outcome typicality manipulation: Patient outcomes (i.e., whether a person experiences being pierced with a needle as painful) influenced Unintentional Empathy, suggesting that the effect is not reducible to affective priming over stimuli alone.

Finally, Experiment 4 connected the component processes underpinning PIT performance to real-world pro-social behavior: donation to breast cancer charities. Unintentional Empathy was higher among participants who did (vs. did not) donate, suggesting that spontaneous empathy assessed by our task corresponds in expected ways with costly helping. Intriguingly, high levels of Unintentional Empathy were associated with maladaptive altruism: Unintentional Empathy was high among participants who donated to an objectively ineffective but socially popular breast cancer charity (Susan G. Komen Foundation). This result complements previous findings that vagal nerve activity has a curvilinear relationship with pro-social behaviors (Kogan et al., 2014), but the current research is unique in examining maladaptive altruism and connecting it to the more proximal psychological process of unintentional empathy. Some empathy appears necessary to sustain pro-social behavior, but at very high levels can backfire, potentially leading to dysregulation and problematic behavioral outcomes.

Our approach captures spontaneous empathy with others' pain and formally models underlying component processes. This measurement advance is important not only methodologically, but also for spurring theoretical advances in the study of empathy (Greenwald, 2012). First, it represents a new behavioral measure of experience sharing that may complement more traditional self-report approaches to empathy measurement. In so doing, this approach captures a type of empathy that has not been studied: counter-intentional empathy that influences judgments despite intentions to the contrary. By distinguishing empathy that operates impulsively and without intent from empathy that operates as a result of active intention, our approach can spur new questions about when these might be expected to dissociate. For instance, do intergroup empathy deficits (Cameron et al., 2015; Cikara et al., 2014) reflect changes in intentional empathy, unintentional empathy, or both? Similarly, our approach can be

used to test whether identifiable versus mass victims elicit different amounts of experience sharing on an intuitive level, or only after response correction (Cameron & Payne, 2011).

Dissociations between intentional and unintentional empathy may also be expected in populations commonly thought to lack empathy (e.g., people high in psychopathic traits; Decety et al., 2013a, 2013b), where desirability in self-reports may mask variation in empathy, and among patients with lesions in empathy-relevant brain regions (e.g., the ventromedial prefrontal cortex; Janowski et al., 2009).

The parameters can be used as predictors and outcomes of pro-social behavior: People higher in Intentional and/or Unintentional Empathy should be more likely to relieve others from painful experiences (e.g., receiving shocks; Batson et al., 1981), and intervening to do so may cause a short-term increase in either form of empathy. Future research should also test for other social influences that might shape the parameter estimates as dependent variables; for instance, Intentional and/or Unintentional Empathy might increase for people high in anxiety (Todd et al., 2015) or decrease for people high in anticipated emotional exhaustion (Cameron et al., 2015). Long-term exposure to settings in which empathy can be difficult, such as in medical care (Haque & Waytz, 2012) or the military (Jackson et al., 2012), might decrease one or both of these processes over repeated assessment. On the other hand, exposure to mindfulness interventions might increase Intentional Empathy, Unintentional Empathy, or both (Condon et al., 2013; Lim et al., 2015).

The current experiments focus on empathy for pain, one of the most widely studied forms of empathy. Future research should generalize beyond the stimuli used here in order to make broader conclusions about empathy. For example, the PIT could be adapted to include empathy for pain stimuli that provide different physical information, such as faces being stuck with

needles (Contreras-Huerta et al., 2013) or hands being subjected to other sources of trauma (e.g., being cut, caught in doors; Jackson et al., 2005). Stimuli could also extend beyond physical pain to depictions of emotional pain (e.g., a crying child) to examine if similar effects emerge for other types of pain, and moreover, if physical pain primes influence judgments of emotional pain and vice versa. The PIT could also be adapted to incorporate dynamic social cues as stimuli (e.g., brief videos of painful experiences occurring in real time, such as pained expressions from hearing aversive sounds, e.g., Lamm et al., 2007; for discussion, see Zaki & Ochsner, 2012) and positive affective experiences (Morelli et al., , 2015). One of the advantages of the PIT is that it can be adapted flexibly to incorporate a broad range of empathic stimuli and to create dissociations between intentional and unintentional empathy.

Across four experiments using a novel sequential priming task, we advance the scientific study of empathy by formally modeling individual differences in empathy for pain, in a manner that bypasses self-report and distinguishes intentional and unintentional forms of empathy. By incorporating implicit measurement and multinomial modeling—each novel methods in the science of empathy—we can increase precision and advance theorizing about empathy (Greenwald, 2012). By providing an efficient behavioral measure of experience sharing of pain, combined with formal modeling, we can quantify who feels empathy without having to ask.

Appendix: Multinomial Model Equations

$$p(\text{accurate}|\text{pain prime \& pain target}) = \text{IE} + (1 - \text{IE}) \times \text{UE} + (1 - \text{IE}) \times (1 - \text{UE}) \times \text{RB}$$

$$p(\text{inaccurate}|\text{pain prime \& pain target}) = (1 - \text{IE}) \times (1 - \text{UE}) \times (1 - \text{RB})$$

$$p(\text{accurate}|\text{pain prime \& neutral target}) = \text{IE} + (1 - \text{IE}) \times (1 - \text{UE}) \times (1 - \text{RB})$$

$$p(\text{inaccurate}|\text{pain prime \& neutral target}) = (1 - \text{IE}) \times \text{UE} + (1 - \text{IE}) \times (1 - \text{UE}) \times \text{RB}$$

$$p(\text{accurate}|\text{neutral prime \& pain target}) = \text{IE} + (1 - \text{IE}) \times (1 - \text{UE}) \times \text{RB}$$

$$p(\text{inaccurate}|\text{neutral prime \& pain target}) = (1 - \text{IE}) \times \text{UE} + (1 - \text{IE}) \times (1 - \text{UE}) \times (1 - \text{RB})$$

$$p(\text{accurate}|\text{neutral prime \& neutral target}) = \text{IE} + (1 - \text{IE}) \times \text{UE} + (1 - \text{IE}) \times (1 - \text{UE}) \times (1 - \text{RB})$$

$$p(\text{inaccurate}|\text{neutral prime \& neutral target}) = (1 - \text{IE}) \times (1 - \text{UE}) \times \text{RB}$$

Acknowledgments

References

- Avenanti, A., Sirigu, A., & Aglioti, S. M. (2010). Racial bias reduces empathic sensorimotor resonance with other-race pain. *Current Biology*, *20*, 1018-1022.
doi: 10.1016/j.cub.2010.03.071
- Bargh, J. A. (1994). The four horsemen of automaticity: Intention, awareness, efficiency, and control as separate issues. In R. S. Wyer, & T. K. Srull (Eds.), *Handbook of social cognition: Vol. 1, Basic processes* (2nd ed., pp. 1–40). Hillsdale, NJ: Erlbaum.
- Batchelder, W. H., & Riefer, D. M. (1999). Theoretical and empirical review of multinomial process tree modeling. *Psychonomic Bulletin & Review*, *6*, 57-86.
doi: 10.3758/BF03210812
- Batson, C. D. (2009). Two forms of perspective taking: Imagining how another feels and imagining how you would feel. In K. D. Markman, W. M. Klein, & J. A. Suhr (Eds.), *Handbook of imagination and mental simulation* (pp. 267–279). New York, NY: Psychology Press.
- Batson, C. D. (2011). *Altruism in humans*. New York: Oxford University Press.
- Batson, C. D., Duncan, B. D., Ackerman, P., Buckley, T., & Birch, K. (1981). Is empathic emotion a source of altruistic motivation? *Journal of Personality and Social Psychology*, *40*, 290-302. doi: 10.1037/0022-3514.40.2.290
- Batson, C. D., Early, S., & Salvarani, G. (1997). Perspective taking: Imagining how another feels versus imagining how you would feel. *Personality and Social Psychology Bulletin*, *23*, 751-758. doi: 10.1177/0146167297237008
- Bishara, A. J., & Payne, B. K. (2009). Multinomial process tree models of control and automaticity in weapon misidentification. *Journal of Experimental Social Psychology*,

- 45, 524-534. doi: 10.1016/j.jesp.2008.11.002
- Cameron, C. D., & Payne, B. K. (2011). Escaping affect: How motivated emotion regulation creates insensitivity to mass suffering. *Journal of Personality and Social Psychology*, 100, 1-15. doi: 10.1037/a0021643
- Cameron, C. D., Harris, L. T., & Payne, B. K. (2015). The emotional cost of humanity: Anticipated exhaustion motivates dehumanization of stigmatized targets. *Social Psychological and Personality Science*. doi: 10.1177/1948550615604453
- Cikara, M., Bruneau, E., Van Bavel, J. J., & Saxe, R. (2014). Their pain gives us pleasure: How intergroup dynamics shape empathic failures and counter-empathic responses. *Journal of Experimental Social Psychology*, 55, 110-125. doi: 10.1016/j.jesp.2014.06.007
- Clerkin, E. M., Fisher, C. R., Sherman, J. W., & Teachman, B. A. (2014). Applying the Quadruple Process model to evaluate change in implicit attitudinal responses during therapy for panic disorder. *Behaviour Research and Therapy*, 52, 17-25. doi: 10.1016/j.brat.2013.10.009
- Condon, P., Desbordes, G., Miller, W. B., & DeSteno, D. (2013). Meditation increases compassionate responses to suffering. *Psychological Science*, 24, 2125-2127. doi: 10.1177/0956797613485603
- Conrey, F. R., Sherman, J. W., Gawronski, B., Hugenberg, K., & Groom, C. J. (2005). Separating multiple processes in implicit social cognition: The quad model of implicit task performance. *Journal of Personality and Social Psychology*, 89, 469-487. doi: 10.1037/0022-3514.89.4.469
- Contreras-Huerta, L. S., Baker, K. S., Reynolds, K. J., Batalha, L., & Cunningham, R. (2013). Racial bias in neural empathic responses to pain. *PLoS ONE*, 8, e84001. doi:

10.1371/journal.pone.0084001

Conway, P., & Gawronski, B. (2013). Deontological and utilitarian inclinations in moral decision making: A process dissociation approach. *Journal of Personality and Social Psychology*, *104*, 216-235. doi: 10.1037/a0031021

Davis, M. H. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of Personality and Social Psychology*, *44*, 113-126. doi: 10.1037/0022-3514.44.1.113

Decety, J., Chen, C., Harenski, C., & Kiehl, K. A. (2013). An fMRI study of affective perspective taking in individuals with psychopathy: Imagining another in pain does not evoke empathy. *Frontiers in Human Neuroscience*, *7*. doi: 10.3389/fnhum.2013.00489

Decety, J., & Cowell, J. M. (2014). Friends or foes: Is empathy necessary for moral behavior? *Perspectives on Psychological Science*, *9*, 525-537. doi: 10.1177/1745691914545130

Decety, J., Echols, S., & Correll, J. (2010a). The blame game: The effect of responsibility and social stigma on empathy for pain. *Journal of Cognitive Neuroscience*, *22*, 985-997. doi: 10.1162/jocn.2009.2166

Decety, J., Skelly, L. R., & Kiehl, K. A. (2013). Brain response to empathy-eliciting scenarios involving pain in incarcerated individuals with psychopathy. *JAMA Psychiatry*, *70*, 638-645. doi: 10.1001/jamapsychiatry.2013.27

Decety, J., Yang, C.-Y., & Cheng, Y. (2010b). Physicians down-regulate their pain empathy response: An event-related brain potential study. *NeuroImage*, *50*, 1676-1682. doi: 10.1016/j.neuroimage.2010.01.025

Decety, J., & Yoder, K. J. (2015). Empathy and motivation for justice: Cognitive empathy and concern, but not emotional empathy, predict sensitivity to injustice for others. *Social*

- Neuroscience*. doi: 10.1080/17470919.2015.1029593
- Ferreira, M. B., Garcia-Marques, L., Sherman, S. J., & Sherman, J. W. (2006). A dual-process approach to judgment under uncertainty. *Journal of Personality and Social Psychology*, 91, 797-813. doi: 10.1037/0022-3514.91.5.797
- Gawronski, B., & Creighton, L. A. (2013). Dual-process theories. In D. E. Carlston (Ed.), *The Oxford handbook of social cognition* (pp. 282-312). New York: Oxford University Press.
- Greenwald, A. G. (2012). There is nothing so theoretical as a good method. *Perspectives on Psychological Science*, 7, 99-108. doi: 10.1177/1745691611434210
- Haque, O. S., & Waytz, A. (2012). Dehumanization in medicine: Causes, solutions, and functions. *Perspectives on Psychological Science*, 7, 176-186. doi: 10.1177/1745691611429706
- Heyes, C. (2011). Automatic imitation. *Psychological Bulletin*, 137, 463-483. doi: 10.1037/a0022288
- Hodges, S. D., & Wegner, D. M. (1997). Automatic and controlled empathy. In W. Ickes (Ed.), *Empathic accuracy* (pp. 311-339). New York: Guilford.
- Jackson, P. L., Brunet, E., Meltzoff, A. N., & Decety, J. (2006). Empathy examined through the neural mechanisms involved in imagining how I feel versus how you feel pain. *Neuropsychologia*, 44, 752-761. doi: 10.1016/j.neuropsychologia.2005.07.015
- Ito, T. A., Friedman, N. P., Bartholow, B. D., Correll, J., Loersch, C., Altamirano, L. J., & Miyake, A. (2015). Toward a comprehensive understanding of executive cognitive function in implicit racial bias. *Journal of Personality and Social Psychology*, 108, 187-218. doi: 10.1037/a0038557.
- Jackson, J. J., Thoemmes, F., Jonkmann, K., Lüdtkke, O., & Trautwein, U. (2012). Military

training and personality trait development: Does the military make the man, or does the man make the military? *Psychological Science*, 23, 270-277. doi:

10.1177/0956797611423545

Jacoby, L. L. (1991). A process dissociation framework: Separating automatic from intentional uses of memory. *Journal of Memory and Language*, 30, 513-541. doi: 10.1016/0749-596x(91)90025_F

Jackson, P. L., Meltzoff, A. N., & Decety, J. (2005). How do we perceive the pain of others? A window into the neural processes involved in empathy. *Neuroimage*, 24, 771-779. doi:10.1016/j.neuroimage.2004.09.006

Jackson, P. L., Brunet, E., Meltzoff, A. N., & Decety, J. (2006). Empathy examined through the neural mechanisms involved in imagining how I feel versus how you feel pain. *Neuropsychologia*, 44, 752-761. doi:10.1016/j.neuropsychologia.2005.07.015

Janowski, V., Camerer, C., & Rangel, A. (2013). Empathic choice involves vmPFC value signals that are modulated by social processing implemented in IPL. *Social Cognitive and Affective Neuroscience*, 8, 201-208. doi: 10.1093/scan/nsr086

Kanske, P., Böckler, A., Trautwein, F. M., & Singer, T. (2015). Dissecting the social brain: Introducing the EmpaToM to reveal distinct neural networks and brain-behavior relations for empathy and Theory of Mind. *Neuroimage*, 122, 6-19. doi: 10.1016/j.neuroimage.2015.07.082

Keren, G., & Schul, Y. (2009). Two is not always better than one: A critical evaluation of two-system theories. *Perspectives on Psychological Science*, 4, 533-550. doi: 10.1111/j.1745-6924.2009.01164.x

- Keysers, C., & Gazzola, V. (2014). Dissociating the ability and propensity for empathy. *Trends in Cognitive Sciences*, 18, 163-166. doi: 10.1016/j.tics.2013.12.011
- Kogan, A., Oveis, C., Carr, E. W., Gruber, J., Mauss, I. B., Shallcross, E., ... & Keltner, D. (2014). Vagal activity is quadratically related to prosocial traits, prosocial emotions, and observer perceptions of prosociality. *Journal of Personality and Social Psychology*, 107, 1051-1063. doi: 10.1037/a0037509
- Lamm, C., Nusbaum, H. C., Meltzoff, A. N., & Decety, J. (2007). What are you feeling? Using functional magnetic resonance imaging to assess the modulation of sensory and affective responses during empathy for pain. *PLoS One*, 2, e1292-e1292. doi: 10.1371/journal.pone.0001292
- Lamm, C., Meltzoff, A. N., & Decety, J. (2010). How do we empathize with someone who is not like us? A functional magnetic resonance imaging study. *Journal of Cognitive Neuroscience*, 22, 362-376. doi: 10.1162/jocn.2009.21186
- Lamm, C., Decety, J., & Singer, T. (2011). Meta-analytic evidence for common and distinct neural networks associated with directly experienced pain and empathy for pain. *NeuroImage*, 54, 2492-2502. doi: 10.1016/j.neuroimage.2010.10.014
- Lim, D., Condon, P., & DeSteno, D. (2015). Mindfulness and compassion: An examination of mechanism and scalability. *PLoS ONE*, 10, e0118221. doi: 10.1371/journal.pone.0118221
- Miller, R. M., Hannikainen, I. A., & Cushman, F. A. (2014). Bad actions or bad outcomes? Differentiating affective contributions to the moral condemnation of harm. *Emotion*, 14, 573-587. doi: 10.1037/a0035361
- Moors, A., & De Houwer, J. (2006). Automaticity: A theoretical and conceptual analysis.

- Psychological Bulletin*, 132, 297-326. doi: 10.1037/0033-2909.132.2.297
- Morelli, S. A., Lieberman, M. D., & Zaki, J. (2015). The emerging study of positive empathy. *Social and Personality Psychology Compass*, 9, 57-68.
doi: 10.1111/spc3.12157
- Nisbett, R. E., & Wilson, T. D. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological Review*, 84, 231-259. doi: 10.1037/0033-295X.84.3.231
- Oakley, B. A. (2013). Concepts and implications of altruism bias and pathological altruism. *Proceedings of the National Academy of Sciences*, 110(Supplement 2), 10408-10415.
doi: 10.1073/pnas.1302547110
- Paulhus, D. L., & Reid, D. B. (1991). Enhancement and denial in socially desirable responding. *Journal of Personality and Social Psychology*, 60, 307-317. doi: 10.1037//0022-3514.60.2.307
- Payne, B. K. (2001). Prejudice and perception: The role of automatic and controlled processes in misperceiving a weapon. *Journal of Personality and Social Psychology*, 81, 181-192.
doi: 10.1037/0022-3514.81.2.181
- Payne, B. K., & Bishara, A. J. (2009). An integrative review of process dissociation and related models in social cognition. *European Review of Social Psychology*, 20, 272-314.
doi: 10.1080/10463280903162177
- Perry, A., Bentin, S., Bartal, I. B. A., Lamm, C., & Decety, J. (2010). "Feeling" the pain of those who are different from us: Modulation of EEG in the mu/alpha range. *Cognitive, Affective, & Behavioral Neuroscience*, 10, 493-504. doi: 10.3758/CABN.10.4.493
- Sherman, J. W., Gawronski, B., Gonsalkorale, K., Hugenberg, K., Allen, T. J., & Groom, C. J.

- (2008). The self-regulation of automatic associations and behavioral impulses. *Psychological Review*, 115, 314-335. doi: 10.1037/0033-29
- Silani, G., Lamm, C., Ruff, C. C., & Singer, T. (2013). Right supramarginal gyrus is crucial to overcome emotional egocentricity bias in social judgments. *The Journal of Neuroscience*, 33, 15466-15476. doi: 10.1523/JNEUROSCI.1488-13
- Smith, A. (1790/2010). *The theory of moral sentiments*. Penguin.
- Todd, A. R., Forstmann, M., Burgmer, P., Brooks, A. W., & Galinsky, A. D. (2015). Anxious and egocentric: How specific emotions influence perspective taking. *Journal of Experimental Psychology: General*, 144, 374-391. doi: 10.1037/xge0000048
- Todd, A. R., Thiem, K. C., & Neel, R. (2016). Does seeing faces of young Black boys facilitate the identification of threatening stimuli? *Psychological Science*, 27, 384-393. doi:10.1177/0956797615624492
- Tusche, A., Böckler, A., Kanske, P., Trautwein, F. M., & Singer, T. (2016). Decoding the charitable brain: Empathy, perspective taking, and attention shifts differentially predict altruistic giving. *The Journal of Neuroscience*, 36, 4719-4732. doi: 10.1523/JNEUROSCI.3392-15.2016
- Van Bavel, J. J., Xiao, Y.J., & Cunningham, W. A. (2012). Evaluation is a dynamic process: Moving beyond dual systems models. *Social and Personality Psychology Compass*, 6, 438-454. doi: 10.1111/j.1751-9004.2012.00438.x
- Zaki, J., & Ochsner, K. N. (2012). The neuroscience of empathy: Progress, pitfalls and promise. *Nature Neuroscience*, 15, 675–680. doi: 10.1038/nn.3085
- Zaki, J., Wager, T. D., Singer, T., Keysers, C., & Gazzola, V. (2016). The anatomy of suffering: Understanding the relationship between nociceptive and empathic pain. *Trends in*

Cognitive Sciences. doi: 10.1016/j.tics.2016.02.003

Acknowledgements

We thank Brandon Anderson, Daniel Chung, Mengzhu Fu, Xiaotian He, Andrea Heinz, Devon Henderson, Sawyer Kieffer, Chance Lacina, Gustav Lundberg, Bekzoda Malikova, Danielle Marvin, Stephanie McKee, Conor Mittauer, Amira Nash, Matthew Neuberger, and Zara Teichroew for assisting with data collection. This research was facilitated by National Science Foundation Grants BCS-1450943 (awarded to CDC), BCS-1523731 (awarded to ART), and a National Science Foundation Graduate Research Fellowship (awarded to VLS).

Figure 1. Sample trial of the Pain Identification Task.

Figure 2. Multinomial processing tree model.

Figure 3. Sample trial of the Pain Identification Task with patient identifiers, Experiment 3.

Table 1

Mean Proportion of Errors on the Pain Identification Task by Prime, Target, and Deadline Condition, Experiment 1

Target	Deadline condition							
	400 ms				800 ms			
	Painful prime	Neutral prime	95% CI	Hedges' g_{av}	Painful prime	Neutral prime	95% CI	Hedges' g_{av}
Painful	0.15 (0.12)	0.29 (0.16)	[0.10, 0.17]	0.94	0.09 (0.11)	0.13 (0.11)	[0.02, 0.07]	0.41
Neutral	0.36 (0.22)	0.18 (0.15)	[0.12, 0.23]	0.91	0.12 (0.13)	0.07 (0.08)	[0.03, 0.08]	0.50

Note. Standard deviations are in parentheses. 95% CIs are for congruent-incongruent mean difference. All simple effects are significant at $p < .001$.

Table 2

Parameter Estimates by Deadline Condition, Experiment 1

Parameter	400 ms deadline condition			800 ms deadline condition			Across conditions	
	Estimate [95% CI]	$\Delta G^2(1)$	w	Estimate [95% CI]	$\Delta G^2(1)$	w	$\Delta G^2(1)$	w
IE	0.51 [0.49, 0.53]	1859.88**	0.76	0.79 [0.78, 0.81]	4419.57**	1.18	455.08**	0.38
UE	0.32 [0.28, 0.36]	220.49**	0.26	0.24 [0.17, 0.31]	41.19**	0.11	3.53 [†]	0.03
RB	0.56 [0.53, 0.59]	17.69**	0.07	0.46 [0.41, 0.51]	6.78	0.03	13.21**	0.06

Note. IE = Intentional Empathy. UE = Unintentional Empathy. RB = Response Bias. [†] $p < .100$ * $p < .050$ ** $p < .010$

Table 3

Mean Proportion of Errors on the Pain Identification Task by Prime, Target, and Perspective-Taking Condition, Experiment 2

Target	Perspective-taking condition							
	Imagine-self				Imagine-other			
	Painful/ needle prime	Neutral/ Q-tip prime	95% CI	Hedges' g_{av}	Painful/ needle prime	Neutral/ Q-tip prime	95% CI	Hedges' g_{av}
Painful	0.15 (0.14)	0.33 (0.21)	[0.13, 0.23]	0.99	0.21 (0.19)	0.31 (0.22)	[0.05, 0.14]	0.46
Neutral	0.35 (0.24)	0.19 (0.17)	[0.11, 0.21]	0.76	0.31 (0.20)	0.21 (0.20)	[0.05, 0.14]	0.48

Note. Standard deviations are in parentheses. 95% CIs are for congruent-incongruent mean difference. All simple effects are significant at $p < .001$.

Table 4

Parameter Estimates by Perspective-Taking Condition, Experiment 2

Parameter	Imagine-self condition			Imagine-other condition			Across conditions	
	Estimate [95% CI]	$\Delta G^2(1)$	w	Estimate [95% CI]	$\Delta G^2(1)$	w	$\Delta G^2(1)$	w
IE	0.49 [0.46, 0.52]	793.35**	0.72	0.48 [0.45, 0.52]	769.04**	0.71	0.16	0.01
UE	0.33 [0.27, 0.39]	114.52**	0.27	0.19 [0.13, 0.25]	39.90**	0.16	11.35**	0.09
RB	0.55 [0.50, 0.59]	4.68*	0.06	0.50 [0.46, 0.53]	0.01	0.00	2.99 [†]	0.04

Note. IE = Intentional Empathy. UE = Unintentional Empathy. RB = Response Bias. [†] $p < .100$ * $p < .050$ ** $p < .010$

Table 5

Mean Proportion of Errors on the PIT and OIT by Prime, Target, and Patient Type, Experiment 3

Task and target	Patient type condition							
	Normal patient				Neurological patient			
	Needle prime	Q-tip prime	95% CI	Hedges' g_{av}	Needle prime	Q-tip prime	95% CI	Hedges' g_{av}
PIT								
Needle	0.24 (0.15)	0.41 (0.17)	[0.15, 0.21]	1.10	0.47 (0.26)	0.50 (0.20)	[-0.00, 0.06]	0.14
Q-tip	0.48 (0.20)	0.31 (0.19)	[0.15, 0.21]	0.88	0.40 (0.15)	0.36 (0.23)	[0.00, 0.07]	0.19
OIT								
Needle	0.35 (0.21)	0.49 (0.18)	[0.11, 0.17]	0.70	0.38 (0.22)	0.52 (0.17)	[0.11, 0.17]	0.72
Q-tip	0.48 (0.17)	0.31 (0.16)	[0.14, 0.20]	1.04	0.48 (0.18)	0.34 (0.18)	[0.10, 0.17]	0.77

Note. Standard deviations are in parentheses. 95% CIs are for congruent-incongruent mean difference. In this Experiment, neurological patients find Q-tips painful and needles neutral. All simple effects $p < .001$ except for the PIT comparisons in the neurological patient condition ($ps = .041, .057$). $N = 144$ for PIT model, $N = 137$ for OIT model.

Table 6

Parameter Estimates by Task and Patient Type, Experiment 3

Task/ Parameter	Normal patient condition			Neurological patient condition			Across conditions	
	Estimate [95% CI]	$\Delta G^2(1)$	w	Estimate [95% CI]	$\Delta G^2(1)$	w	$\Delta G^2(1)$	w
PIT								
IE	0.28 [0.27, 0.29]	1533.31**	0.58	0.14 [0.12, 0.15]	347.65**	0.27	206.87**	0.21
UE	0.24 [0.22, 0.26]	624.76**	0.37	0.04 [0.02, 0.06]	23.02**	0.07	251.23**	0.23
RB	0.56 [0.55, 0.58]	104.49**	0.15	0.56 [0.55, 0.57]	196.13**	0.21	0.18	0.01
OIT								
D	0.19 [0.17, 0.20]	646.73**	0.38	0.15 [0.13, 0.16]	384.96**	0.30	16.90**	0.06
AB	0.19 [0.17, 0.20]	424.65**	0.31	0.16 [0.15, 0.18]	342.54**	0.28	4.41*	0.03
RB	0.48 [0.47, 0.49]	29.68**	0.08	0.47 [0.46, 0.48]	10.66*	0.05	1.74	0.02

Note. PIT = Pain Identification Task, OIT = Object Identification Task. In the PIT, IE = Intentional Empathy, UE = Unintentional Empathy, and RB = Response Bias. In the OIT, D = Discriminability, AB = Accessibility Bias, and RB = Response Bias. [†] $p < .100$
^{*} $p < .050$ ^{**} $p < .010$

Table 7

Mean Proportion of Errors on the Pain Identification Task by Prime, Target, and Deadline Condition, Experiment 4

Target	Deadline condition							
	400 ms				800 ms			
	Painful prime	Neutral prime	95% CI	Hedges' g_{av}	Painful prime	Neutral prime	95% CI	Hedges' g_{av}
Painful	0.25 (0.17)	0.44 (0.16)	[0.16, 0.22]	1.13	0.10 (0.10)	0.18 (0.16)	[0.05, 0.10]	0.58
Neutral	0.45 (0.20)	0.25 (0.16)	[0.18, 0.24]	1.13	0.19 (0.20)	0.09 (0.10)	[0.07, 0.14]	0.66

Note. Standard deviations are in parentheses. 95% CIs are for congruent-incongruent mean difference. All simple effects are significant at $p < .001$.

Table 8

Parameter Estimates by Deadline Condition and Donation Type, Experiment 4

DL/ Param.	Donated to Susan G. Komen Foundation			Donated to Breast Cancer Research Foundation			No Donation			Across Donation Groups	
	Estimate [95% CI]	$\Delta G^2(1)$	w	Estimate [95% CI]	$\Delta G^2(1)$	w	Estimate [95% CI]	$\Delta G^2(1)$	w	$\Delta G^2(2)$	w
400ms											
IE	0.31 [0.28, 0.34]	466.38**	0.25	0.31 [0.30, 0.33]	880.54**	0.34	0.25 [0.21, 0.29]	140.79**	0.14	8.22*	0.03
UE	0.30 [0.27, 0.34]	220.36**	0.17	0.29 [0.26, 0.32]	368.89**	0.22	0.22 [0.18, 0.27]	64.54**	0.09	5.86 [†]	0.03
RB	0.51 [0.48, 0.54]	0.81	0.01	0.49 [0.48, 0.51]	0.60	0.01	0.53 [0.50, 0.56]	2.69	0.02	3.72	0.02
800ms											
IE	0.72 [0.70, 0.74]	3320.01**	0.67	0.71 [0.69, 0.72]	4454.73**	0.77	0.72 [0.68, 0.75]	689.91**	0.30	0.89	0.01
UE	0.38 [0.32, 0.45]	138.48**	0.14	0.28 [0.22, 0.34]	108.60**	0.12	0.26 [0.13, 0.40]	13.68**	0.04	7.23*	0.03
RB	0.46 [0.40, 0.50]	2.84 [†]	0.02	0.48 [0.45, 0.52]	0.73	0.01	0.59 [0.50, 0.69]	4.00*	0.02	6.56*	0.03
Across											
IE		619.17**	0.29		898.03**	0.35		222.10**	0.17		
UE		5.09*	0.03		0.05	0.00		0.24	0.01		
RB		3.64 [†]	0.02		0.14	0.00		1.67	0.01		

Note. DL = Deadline condition. “Across” refers to comparisons in which the relevant parameter is constrained across the 400ms vs. 800ms deadline manipulation. IE = Intentional Empathy. UE = Unintentional Empathy. RB = Response Bias. [†] $p < .100$ * $p < .050$ ** $p < .010$