UNIVERSITY OF CALIFORNIA

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Interpersonal Neural Dynamics Underlying Empathy and Shared Experience

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

by

Lianne Nicole Barnes

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ABSTRACT OF THE DISSERTATION

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Professor Matthew D. Lieberman, Chair

In empathy toward emotional distress, the relationship between empathizer and empathy target may change dependent upon whether empathizers have personal experience with the emotionally distressing event, representing a shared experience between empathizer and empathy target. This research explored the neural and behavioral correlates of two key empathy-related processes, empathic concern and personal distress, as they pertain to shared experience. These processes were examined for empathy for an emotionally distressing event (e.g., the loss of a loved one) in empathizers who themselves had prior experience with losing a loved one compared to empathizers with no experience with loss. In addition to shared experience, Paper 1 examined neural correlates of empathic concern and personal distress using functional near-infrared imagery (fNIRS), and also explored how empathic concern, personal distress, and shared experience each relate to the likelihood of offering support as well as quality of any support

offered. Paper 2 examined neural synchrony between empathizers and a storyteller empathy target as it pertained to shared vs. non-shared experience with losing a loved one. Paper 2 also tested the effects of a mindful attention intervention on empathic concern and personal distress, with the goal of reducing personal distress while maintaining empathic concern. Contributions to social neuroscience research and implications for support providers are discussed.

The dissertation of Lianne Nicole Barnes is approved.

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Dedication

This dissertation is dedicated to all the participants throughout my graduate research who have shared their stories of loss and pain. I have been amazed by their willingness to be vulnerable and share stories with strangers about some of their hardest moments. They have evoked empathy and in hundreds of participants, as well as in me, and I will be forever grateful.

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Burns, S.M., Barnes, L.N., Katzman, P.L., Ames, D.L, Falk, E.B., & Lieberman, M.D. (2017). A functional near infrared spectroscopy (fNIRS) replication of the sunscreen persuasion paradigm. *Social Cognitive and Affective Neuroscience*.

McCarthy, J. D., Barnes, L. N., Alvarez, B. D., & Caplovitz, G. P. (2013). Two plus blue equals green: Grapheme-color synesthesia allows cognitive access to numerical information via color. *Consciousness and cognition*, *22*(4), 1384-1392.

MANUSCRIPTS IN PREPARATION

Barnes, L.N., & Lieberman, M.D. (2019). Dissociating Empathic Concern and Personal Distress in the Brain using Functional Near-Infrared Spectroscopy. Manuscript in preparation.

Barnes, L.N., & Lieberman, M.D. (2019). Interpersonal Neural Dynamics of Shared Experience. Manuscript in preparation.

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Barnes, L. N., & Lieberman, M. D. (2018). You've Been There: The Impact of Credentialing on Successful Empathizing. Manuscript in preparation.

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Overview

We are often placed into the role of empathizer as we encounter others who are experience some form of distress, whether large or small. When we encounter others' distress, there are several empathy-related processes that may occur. For one, we may feel a concern for the individual, and perhaps a desire to alleviate their pain. We may also feel our own distress at seeing someone else in pain, which may lead us to want to reduce the other's distress so we can feel less distress, or may instead lead us to disengage from the other so as not to see their distress anymore. These two empathy-related processes, empathic concern and personal distress, have long been the focus of research looking for distinctions between them, both in their phenomenology and their ability to predict empathically-motivated prosocial behavior.

Behavioral research has shown these to be distinct constructs (Batson, O'Quin, Fultz, & Vanderplas, 1983) and recent neuroimaging research using functional magnetic resonance imaging (fMRI) has also found brain regions distinct to each construct (Ashar, Andrews-Hanna, Dimidjian, & Wager, 2017). The research in this dissertation looked to extend these findings to a new form of neuroimaging: function near infrared spectroscopy (fNIRS). fNIRS has become a useful tool for social neuroscientists looking to increase ecological validity of their studies, as it allows for greater freedom of movement for participants. This freedom of movement and ability to more actively interact with stimuli is of particular importance when investigating complex social phenomena such as empathy for emotional distress. Establishing regions of interest for empathic concern and personal distress using fNIRS would provide researchers a means of studying how these constructs connect to behavior in a more ecologically valid manner. As such, this research aimed to use fNIRS to dissociate between personal distress and empathic concern in

the brain, using real video stories of other participants talking about emotionally painful experiences.

Another benefit fNIRS brings to the table is the ease in which researchers can compare neural activation across participants to determine the level of synchrony between brains. As fNIRS is considerably less expensive than fMRI and easier to run, researchers can quickly collect larger samples in order to look at synchrony between groups. Neural synchrony is especially relevant for empathy research, as one major pathway for empathy in the brain is the mirror network, in which observed pain is simulated, or mirrored, in the observer's own brain (Gallese, Keysers, & Rizzolatti, 2004). If observers are simulating what would happen in their own brain were they to experience the same pain as the person they are observing, then it follows that the observers' brains may in fact be mirroring the brain of the person they are observing, at least in regions that belong to this mirror network. Personal distress has been shown to correlate with activation in mirror regions accessible to fNIRS, such as the supplementary motor area, premotor cortex, and somatosensory cortices (Ashar et al., 2017). This research also aimed to establish neural synchrony as a useful tool for looking at personal distress in mirror regions.

Neural synchrony may also relate to another, under-researched, construct: shared experiential history with a particular type of emotional pain. For example, if someone has experienced grief after losing a loved one, and then listens to someone talk about their own experience of losing a loved one, these individuals have both gone through a similar experience, which could be reflected in their neural activation. Shared experience with a specific pain could lead to greater neural synchrony. It is an open question, though, whether that synchrony would occur in regions related to personal distress, regions related to empathic concern, or potentially both.

To explore this relationship between shared experience and neural synchrony, we first need to establish whether individuals who have shared an experience with an empathy target report feeling more empathic concern and/or personal distress than individuals who have not shared the experience. Considering the role of neural simulation in empathy, and its correlation with personal distress, it is a reasonable hypothesis that individuals who have shared a painful experience may report more personal distress than individuals who have not had that painful experience. Research on shared experience and empathy for emotional experiences is sparse, and the results are mixed. Some studies suggest that shared experience may cause greater empathic concern (Barnett, Tetreault, & Masbad, 1987; Batson et al., 1996), greater overall empathy (Eklund, Andersson-Stråberg, & Hansen, 2009; Hodges, Kiel, Kramer, Veach, & Villanueva, 2010), or greater personal distress (Barnett, 1983). This inconsistency may stem in part from the different ways empathic concern and personal distress are measured and/or defined, but may also be due in part to the fact that empathic concern and personal distress tend to be moderately correlated with one another (Davis, 1983), making it difficult to parse out their unique relationships to other variables such as shared experience. The research in this dissertation aimed to determine the role shared experience plays in uniquely motivating personal distress versus empathic concern, when controlling for the other.

Determining unique relationships of empathic concern and personal distress to shared experience is particularly important when considering prosocial behavior, as they are differentially related (Batson, O'Quin, Fultz, & Vanderplas, 1996). Empathic concern is historically a strong predictor of prosocial behavior, while personal distress appears to sometimes motivate prosocial behavior and sometimes motivate escape from the distressed individual. As such, personal distress tends to be uncorrelated or slightly negatively correlated

with prosocial behavior (Batson et al., 1996, Eisenberg et al., 1989). Since personal distress is less likely to promote prosocial behavior, and since shared experience may be related to greater personal distress, one could hypothesize that individuals who have shared an experience may be less likely to provide support, a form of prosocial behavior, to the empathy target than individuals who hadn't shared the experience. However, there is some preliminary evidence to the contrary, as in a study where adult survivors of childhood abuse were more likely intervene in a simulated child abuse scenario (Christy & Voigt, 1994). Additionally, there is very little research assessing the quality of any support offered by individuals who have shared a painful experience, but based on limited findings, it appears that shared experience may increase perceived effectiveness of support offered (Goldstein, Vezich, & Shapiro, 2014; Hodges et al., 2010). This dissertation aimed to extend the research on shared experience's influence on prosocial behavior to determine how shared experience, personal distress, and empathic concern all relate to amount and quality of support offered.

As discussed, while sometimes motivating prosocial behavior, personal distress is inherently aversive, and so can suppress support an individual might otherwise have offered. Reducing personal distress is then an important step for increasing support for those in need of emotional support. However, finding a mechanism for reducing personal distress is more challenging than may first appear, as any such mechanism should reduce personal distress without also reducing empathic concern, the empathy-related process that is the strongest predictor of prosocial behavior. Emotion regulation strategies such as cognitive reappraisal, in which the individual attempts to change their construal of the situation or their response, can sometimes be effective at reducing only personal distress (Lebowitz & Dovidio, 2015), but at

other times can lead to more global down-regulation of affect, which may reduce prosocial behavior (Haque & Waytz, 2012; Hodges & Biswas-Diener, 2007).

In addition to some applications of cognitive reappraisal, another mechanism that may selectively reduce personal distress, without also reducing empathic concern, is mindful attention. Based on the Buddhist practice of mindfulness, mindful attention is a form of emotion regulation in which an individual aims to be aware of their emotions without actively trying to change or suppress them. Personal distress causes a greater focus on one's own emotional state, rather than the state of the empathy target, and empathizers may struggle against their distressing response. Mindful attention could encourage an empathizer to accept their own distress, thus allowing the empathizer's mental focus to shift away from themselves and back toward the empathy target. The research in this dissertation adapted a mindful attention training that has previously been found to be effective at reducing nicotine craving in smokers (Westbrook et al., 2013) with the goal of reducing personal distress in empathizers without also reducing empathic concern. The research also explored whether a mindful attention intervention would be especially effective for individuals who had shared the distressing experience, or if the intervention would be effective regardless of prior history with the distressing experience.

In summary, this research aimed to a) use fNIRS to dissociate empathic concern and personal distress in the brain, b) explore how shared experience impacts neural synchrony in regions related to personal distress and empathic concern, c) determine how shared experience impacts empathic concern, personal distress, and any resultant prosocial behaviors, and d) explore a potential mechanism for reducing personal distress in participants who have prior experience with a distressing event. The research addressed these aims through two studies that utilized both fNIRS neuroimaging and behavioral measures.

Paper 1

Dissociating Empathic Concern and Personal Distress using Functional Near-Infrared Spectroscopy

Abstract

The current study examined the neural and behavioral correlates of empathic concern and personal distress when viewing distressing stimuli of individuals talking about losing a loved one, both in participants who have experienced a similar distressing occurrence (shared experience participants) and those with no experience with the distressing occurrence (non-shared experience participants). Correlations of neural activation timecourse to continuous affect ratings showed a region of supplementary motor area and premotor cortex that was positively correlated with personal distress affect ratings. No regions correlating with empathic concern affect ratings were identified. When viewing the videos, shared experience participants reported feeling similar levels of empathic concern as non-shared experience participants, but reported significantly more personal distress. On average, shared experience participants were as likely to offer support to storytellers as non-shared experience participants, and the support they offered was significantly higher quality than support from non-shared experience participants. Implications for empathy research and social support providers are discussed.

Dissociating Empathic Concern and Personal Distress using Functional Near-Infrared Spectroscopy

When we encounter someone in distress, we may experience a variety of emotional states, referred to collectively as empathy, in which we share in the other's emotions and feel a desire to reduce their distress. One facet of empathy we may feel is *personal distress*, in which we share in the other's distressing emotions and feel distress ourselves at the fact that the other is hurting. We may therefore feel a desire for the other to no longer be in distress so that we, too, are no longer in distress. In addition to personal distress, we may feel a compassion, or *empathic concern*, for the other, in which we care about the other's well-being and have a desire for the other person to no longer be in distress for their sake instead of our own.

Dissociating empathic concern and personal distress. Empathic concern (sometimes referred to as empathic care, empathy, or sympathy) and personal distress (sometimes referred to as empathetic distress or just distress) are distinct constructs (Batson, Fultz, & Schoenrade, 1987; Batson, O'Quin, Fultz, & Vanderplas, 1983; Davis, 1983; Eisenberg & Eggum, 2009). Numerous studies by Batson and colleagues demonstrated how these constructs are distinct by using factor analyses. The researchers presented participants with a series of synonymous emotion words related to empathic responding, and then conducted factor analyses that demonstrated that personal distress loads onto a separate factor from empathy/empathic concern (Batson, Fultz, et al., 1987; Batson, O'Quin, et al., 1983).

Neuroscientific evidence also supports the idea that empathic concern and personal distress are separate constructs and may utilize distinct neural pathways. Compared to personal distress, empathic concern is more strongly correlated with prosocial behavior, and such behavior is linked to greater activation in the ventromedial prefrontal cortex (vmPFC) as well as

the ventral striatum and the precuneus region (Morelli ,2015; Zaki & Mitchell 2011). In behavioral research, personal distress is more strongly associated with cues of physical or emotional pain, and is characterized by the empathizer simulating the target's pain. Neural regions recruited for such simulation include the premotor cortex, supplementary motor area, somatosensory cortices, inferior parietal lobe, and inferior frontal gyrus (Iacoboni & Dapretto 2006, Gallese et al., 2004). Neural regions associated with the experience of distress include the dorsal anterior cingulate cortex (dACC), the dorsomedial prefrontal cortex (dmPFC), and the anterior insula (Bruneau, Pluta, & Saxe, 2012; Lamm 2011).

Notably, only one study to date has aimed to use participants' self-reported empathic concern and/or personal distress to predict neural activity, in order to reliably dissociate neural regions recruited by either construct (Ashar et al., 2017). Ashar and colleagues used a functional magnetic resonance imaging (fMRI) task to look for brain markers associated with these constructs, in which participants listened to recorded stories of hardship and rated their emotions while being scanned. Regions associated with empathic concern included the medial orbitofrontal cortex (mOFC), vmPFC, ventral striatum, and the septal region. Regions associated with personal distress included the left ventral premotor cortex, bilateral inferior parietal lobe, bilateral somatosensory cortex, and the left mid-insula.

While fMRI allows for greater precision in neuroimaging, it also creates an artificial, highly-controlled environment in which participants must hold completely still. Functional near-infrared spectroscopy (fNIRS), on the other hand, uses near-infrared light to measure neural activation in the cerebral cortex, and is much more robust in terms of movement, allowing participants to sit up and engage with stimuli in a more natural manner. fNIRS then provides less precise measurement but greater ecological validity than fMRI, which could advance empathy

research by allowing researchers to look at empathically-related neural activation while participants are sitting up and more actively engaging with stimuli. In terms of differentiating between the aforementioned two types of empathy-related processes, fNIRS could be used to look at the vmPFC for empathic concern, while regions of personal distress measurable by fNIRS include the premotor cortex, supplementary motor area, and the somatosensory cortices. Thus the first major aim of this research was to establish fNIRS as a viable tool for dissociating between empathic concern and personal distress in the brain.

Predicting prosocial behavior. Empathic concern and personal distress can each motivate us to provide support for someone in pain, albeit through different pathways, but personal distress can also motivate us to withdraw from the other in order to no longer feel their distress (Batson, O'Quin, et al., 1983). Batson, et al. (1983) tested the influence of empathic concern and personal distress on prosocial behavior through a series of experiments in which participants observed a confederate in a distressing situation, a task in which the confederate supposedly received shocks, and then manipulated how easy it would be for participants to 'escape' their distress by either leaving the situation or offering help to the confederate by switching roles. After 2 trials, participants rated their empathic concern and personal distress, and then either thought they could leave or thought they would have to stay and watch 8 more trials. The experimenters then asked if the participant would switch places with the confederate and complete the shock task.

For analyses, participants were categorized based on whether they felt more empathic concern or more personal distress. In the easy-escape condition, in which they didn't think they would have to watch or participate in the rest of the trials but instead could just leave the study, the researchers found that participants who felt more empathic concern than personal distress

were more likely to offer help. Participants were more likely to help when escape was difficult regardless of whether they felt more empathic concern or personal distress, demonstrating that personal distress can also motivate helping, albeit with a more self-focused motivation of reducing the participant's distress at viewing the other participant in pain. These results were replicated in two similar studies. Empathic concern is therefore a more reliable instigator of prosocial behavior, while personal distress tends to be uncorrelated with prosocial behavior as it sometimes motivates helping and sometimes motivates 'escaping' (Batson et al., 1987).

While researchers have successfully identified roles of empathic concern and personal distress in predicting prosocial behavior, it is possible (and perhaps usual) for individuals to feel both emotions simultaneously, thus muddying the waters in terms of how much each emotion is motivating resultant prosocial behavior. In efforts to separate these constructs, researchers have largely ignored how they interact with each other and how that interaction impacts prosocial behavior. For example, in Batson's 'ease of escape' studies, participants reported feeling both empathic concern and personal distress, but were categorized based on which they experienced more strongly. This places the emphasis on which emotion is felt more than the other, rather than looking at the unique role each plays in motivating prosocial behavior.

The research in this dissertation addressed the question of the unique role personal distress plays in motivating a specific type of prosocial behavior, emotional support, by looking at how personal distress and empathic concern correlate with prosocial behavior when accounting for the other. Personal distress was then defined as the residual remaining when variance shared with empathic concern was regressed out of the variable, and empathic concern was defined as the residual when the variance it shares with personal distress is regressed out as well.

Shared experience. Another area that has been largely overlooked in the empathy literature is how levels of experienced empathic concern and personal distress may differ depending upon whether the empathizer has themselves experienced a similar distressing event as the person with whom they are empathizing. Some behavioral research supports the idea that having shared an experience causes an individual to feel more empathy in general and empathic concern in particular (Barnett, Tetreault, & Masbad, 1987; Batson, et al., 1996; Eklund, Andersson-Stråberg, & Hansen, 2009; Hodges, Kiel, Kramer, Veach, & Villanueva, 2010). For example, Barnett, Tetreault and Masbad (1987) found that participants who were themselves survivors of rape reported greater empathy when watching a video of a woman talking about her own experience of rape than participants who reported no experience of sexual violence. Relevant to the previous discussion of unique contributions of empathic concern, the researchers in this study calculated empathy as the difference between empathic concern and personal distress, meaning that, on average, survivor participants reported a greater difference between empathic concern and personal distress than participants with no experience of rape. While providing early evidence that shared experience impacts empathy, this study offered no insight on absolute values of empathic concern and personal distress in individuals who have shared an experience compared to those who have not shared the experience, nor did it explore shared experience's relationship to empathic concern and personal distress controlling for shared variance between the constructs.

In another study exploring shared experience, Hodges et al. (2010) looked at general empathy for new mothers in participants who either had never been pregnant, were pregnant with their first child, or who had recently given birth to their first child. Empathizer participants watched videos of new mothers talking about their experience, and then reported on their

feelings of empathic concern for the mother in the video. Empathy increased parametrically with similarity of experience, such that participants who were pregnant reported more empathy than those who had never been pregnant, and new mother participants reported more empathy than pregnant participants. Personal distress was not explicitly measured in this study. Eklund, Andersson-Stråberg, and Hansen (2009) also looked at how shared experience influences general empathy, by presenting participants with short stories about someone who was afraid of darkness, someone who was afraid of loss, someone who had a pet die, and someone who had a parent die. The researchers measured self-reported similarity of experience and general empathy toward the person in the stories as continuous variables and found that similarity of experience predicted felt empathy. This effect was strongest for loss of a parent and weakest for loss of a pet.

Looking at physical, rather than emotional, pain, prior experience with a pain and perceived similarity do seem to predict general empathy (Preis & Kroener-Herwig, 2012). Using pressure pain, Preis and Kroener-Herwig looked at 'emotional response' and perspective-taking when participants who received pain viewed photos of others receiving pressure pain, compared to individuals who instead received a light touch (2012). The two factors of empathy reported were measured using the Goettinger Inventory for the Assessment of State Empathy, and items related to emotional empathy in that scale have been shown to correlate with both the empathic concern and personal distress subscales of the Interpersonal Reactivity Index (IRI), while the perspective-taking factor correlates with the perspective-taking and fantasy-seeking subscales of the IRI. The researchers found that perceived similarity was associated with emotional response, while prior experience predicted greater perspective-taking. However, perceived similarity in this study could have included prior experience in the participants' minds, as they only had images of

the models' left hands receiving pressure pain upon which to determine similarity; with so little information upon which to base similarity, the identical experience of receiving physical pain or a light touch in the laboratory environment could be considered similarity.

In the empathy literature, research on explicitly-measured empathic concern vs. personal distress in shared experience is scarce. Only one study to date has reported information on absolute values of both empathic concern and personal distress with regards to what the authors define as shared experience. Batson et al. conducted two experiments demonstrating that shared experience causes women to feel greater empathic concern; results for men were inconsistent (1996). In the first experiment, participants watched a confederate receive uncomfortable electric shocks while performing a digit recall task. Some participants merely watched (no shared experience), while others were prepped to receive shocks themselves before being told they had be assigned to the wrong role, and then watched the confederate receive the shocks (limited shared experience). Women participants who had been prepped to be shocked reported more empathic concern for the confederate than those participants who merely watched; no significant differences emerged for personal distress. In the second study, participants read anecdotes about either experiencing severe acne as an adolescent or experiencing rejection from a long-term dating partner. Women participants who had been through a similar incident reported greater empathic concern for the person in the story than those who had not experienced the event described (Batson et al., 1996).

For self-reported personal distress in these two studies by Batson et al., there were no significant differences between participants who only watched and participants who were led to believe they would receive shocks first (Batson et al., 1996). While this latter condition is referred to as shared experience, the participants did not feel any shock themselves and thus had

no way to compare their emotions when watching the confederate receive shocks to the emotions they may have felt, had they received shocks. The psychological experience of thinking one is going to receive shocks and then not receiving those shocks would likely comprise feelings of dread and relief, which one could argue are fundamentally different from the psychological experience of actually going through the shock procedure and then observing someone else receive shocks. For the second study, participants read short vignettes written by the experimenters, which has been shown to have less emotional salience and evoke less empathy than more dynamic visual stimuli such as recorded imagery (Joffe, 2008.)

Research on preschool-aged children showed that shared experience did in fact increase implicitly-measured personal distress, compared to participants who had not shared an experience (Barnett, 1983). Children in the study played a game and were told they either failed or succeeded, or were given no feedback. After playing, the participants then watched a video of another child playing the game and being informed they had failed. Participants who had also failed the game (i.e., they shared the experience of failure) reported that the child in the video was sadder than participants in the other conditions, and displayed more distress in their facial expressions while watching the video (Barnett, 1983). This study provides implicit evidence for increased personal distress with shared experience and suggests that, having been through similar experiences, an empathizer may in fact feel greater personal distress than someone who has no direct knowledge of the distressing event. Therefore we predicted that shared experience in the present research would also increase personal distress.

Shared experience and prosocial behavior. Evidence regarding the relationship between shared experience and prosocial behavior is mixed (Cao & Lin, 2015; Christy & Voigt, 1994; Small & Simonsohn, 2008). In a study of bystander intervention in child abuse, Christy

and Voigt (1994) found that bystanders who had previous experience with child abuse, either as a victim or bystander, were more likely to intervene and were more certain about the correct way to intervene, based on their previous experiences. Cao & Lin (2015) looked at teen victims of cyberbullying as a shared prior experience, and found that girls who had previously been bullied online were more likely to act prosocially when viewing online interactions in which someone else was being cyberbullied, compared to girls who had not experienced cyberbullying themselves. Boys, on the other hand, enacted more *anti*social behavior if they had themselves been victims of cyberbullying (Cao & Lin, 2015). While not a direct experience, Small and Simonsohn (2006) found that participants who had friends experience a specific loss were more likely to behave prosocially toward a stranger experiencing the same loss. Given these sparse and mixed findings, further research is needed to clarify the relationship between shared experience and prosocial behavior. Additionally, if shared experience evokes greater personal distress, which can reduce prosocial behavior, yet shared experience either motivates more prosocial behavior or does not show reduction in prosocial behavior compared to non-shared experience, then shared experience could be an important moderator of the relationship between personal distress and prosocial behavior.

Finally, research on shared experience and on empathy in general rarely explores the effectiveness of any resultant prosocial behavior. In the study of pregnant mothers by Hodges, et al. (2010), participants wrote letters to empathy 'targets,' pregnant women, who then rated how well they felt the letter-writers understood them. Targets rated letter-writers who were new mothers or also pregnant as more understanding than letter-writers who had never been pregnant. In a series of studies exploring how empathy targets respond to perceived perspective-taking, targets who felt their conversational counterpart successfully took their perspective reported

liking their counterpart more and seeing greater self/other overlap with the counterpart (Goldstein et al., 2014). While most of these studies did not provide information about shared experience, one study used as the conversational counterpart a supposed student council candidate who claimed to be able to take the perspective of students struggling financially with tuition and other expenses related to college. Researchers experimentally manipulated whether target participants were told the student council candidate came from a middle-class background or an extremely wealthy background, providing implicit evidence for whether the candidate could possibly have shared the experience of struggling with finances during college. Again, participants reported liking the candidate more when they claimed to be able to take the perspective of struggling students, but only if participants also thought the candidate came from a middle-class background. Participant SES was not measured, nor was effectiveness of any support offered, but this study provides some preliminary evidence that those who have shared an experience may be able to offer better-received support.

It should be stated that not every shared experience should necessarily cause an individual to empathize more, either in terms of empathic concern or personal distress, or cause an increase in related prosocial behavior (Ruttan, McDonnell, & Nordgren, 2015). Most people have shared the experience of losing their keys, but observing someone else talk about losing keys likely will not evoke strong emotions in an observer, regardless of their personal experience with losing keys. In this research, we define a shared experience as one which is sufficiently negative to evoke both empathic concern and personal distress in an observer. Additionally, in order to compare shared and non-shared experience conditions, we define a shared experience as one that is relatively uncommon in the population from which we drew our sample. Based on pretesting of undergraduate samples, we determined that experiencing the death of a close other,

such as a close relative, friend, partner, or roommate, was both sufficiently negative to evoke empathy and sufficiently rare to allow comparisons between shared and non-shared experience samples.

Current Study and Hypotheses

Three primary goals guided this study. First, we examined whether empathic concern and personal distress could be reliably dissociated using fNIRS and continuous affect ratings. This was an exploratory hypothesis, and as such we used whole brain analyses to determine channels of neural data that covary with personal distress and/or empathic concern.

Second, we aimed to discover whether individuals who have been through a similar experience to the story with which they were empathizing (hereafter referred to as shared experience participants) differed from participants who have not been through the experience (hereafter referred to as non-shared experience participants) in terms of self-reported, state-level empathic concern and personal distress, calculated as the unique contribution of each construct. We hypothesized that, overall, participants would feel more empathic concern and personal distress when watching videos about losing a loved one (referred to as loss videos) than when watching a control video. For personal distress, we hypothesized that there would be an interaction between shared experience and video type such that shared experience participants would report greater personal distress for the loss videos than non-shared experience participants.

Finally, we examined whether the unique contributions of empathic concern or personal distress when controlling for the other more effectively predicted effectiveness of offered support. We hypothesized that unique felt empathic concern would significantly predict both

likelihood of offering support and quality of offered support, while felt personal distress on its own would only significantly predict likelihood of offering support to storytellers who had lost a loved one. We also hypothesized that shared experience participants would offer more effective support to storytellers who had lost a loved one, compared to support offered by non-shared experience participants.

Method

Participants

Participants were undergraduate students at the University of California, Los Angeles.

Only women (n = 81, *M* age = 20.22, *SD* = 1.2) were recruited for the study. Participants were 25.9% White, 3.7% Black, 12.3% Latinx, 42% Asian, and 16% multiracial. Shared experience participants (who had lost a close other to a death) were 49.4% of the sample (N = 40), while non-shared experience participants were the remained 50.6% of the sample (N = 41). 21 participants' neuroimaging data were unusable due to calibration issues or file corruption, and so were not included in neural analyses.

Materials

Imaging technology. This project used fNIRS as a neuroimaging alternative to fMRI. Specifically, a NIRScout imaging unit from NIRx was used (nirx.net/nirscout), a unit which has 32 light sources and 32 light detectors, creating 108 channels of data, which allowed a cap configuration covering the majority of the cerebral cortex. fNIRS spatial resolution margin is around 1cm. Four elastic head caps ranging in size were used in order to affix the light sources and detectors to participants' heads. We used the 10-10 UI external positioning system to

standardize spatial positioning across participants**.** Light intensity data was collected at wavelengths of 760 and 850nm and sampling rate of 1.95 Hz.

Study items. For the main task, the Continuous Affect Rating and Media Annotation (CARMA) software was used to present video stimuli and collect participants' affect ratings (Girard, 2014). This software provides an affect-rating bar on the side of the screen over which participants move a cursor up and down while they watch a video in the main portion of the screen. The software allows for different labels to be used for which participants are rating the stimuli.

Participants viewed one control video and two loss videos. Video stimuli were collected prior to the current study. The control video, which was a story about a difficult roommate, was used because it was a negative-affect story to which most-to-all participants could relate in some form. This video was 90 seconds long The loss videos were negative-affect stories about losing a loved one to which only some participants could relate, and were 85 and 111 seconds long. All stimulus video storytellers were matched with study participants for gender and approximate age. Loss videos were acquired during a prior study and were undergraduate women participants. The control video was recorded by a research assistant blind to study hypotheses. For both control and loss condition videos, the storyteller was instructed to avoid personal identifiers and to focus mainly on their emotional experiences during and after the event discussed.

Procedure

Participants were recruited using recruitment emails distributed by the UCLA Registrar's Office. These recruitment emails were sent pseudo-randomly to undergraduate women. Potential participants who replied to the email were screened for inclusion criteria, including gender, right-

handedness, English language fluency, age of at least 18, and the loss of a close other within the last 3 years, depending on the recruitment email. This latter inclusion criterion was included in order to recruit shared-experience participants exclusively, while recruitment emails without this criterion recruited mostly participants who had not lost anyone close to them. However, any participants recruited through general recruitment emails who reported during the study survey that they had lost a close other were classified as shared experience participants in analyses.

Participants who met all inclusion criteria completed the study over approximately 1 hour in a laboratory setting. After providing consent, participants were fitted for the correct size fNIRS cap. While experimenters prepared the fNIRS cap, participants completed a survey in which they learned the definitions of empathic concern and personal distress (see Appendix A). After reading the definitions and submitting a short-answer definition in their own words, participants completed a short quiz on the differences between these constructs. For participants who scored below 60%, written definitions were analyzed to determine whether the participant successfully understood the differences between empathic concern and personal distress, and one participant was excluded due to answers on the quiz and short-answer definitions.

Following the quiz, experimenters fitted the fNIRS cap onto participants and completed calibration and baseline scans. Participants were instructed that they would be viewing three videos, and that for each video they should imagine that they are in a conversation with that person, referred to as their 'conversation partner,' in order to increase ecological validity of the study. Participants first viewed the control video and rated the story from 'very interested' to 'not interested at all.' Neural activation was recorded simultaneous with affect ratings. After completing the control video, participants completed a questionnaire about the person whose video they just watched (see Appendix A). This questionnaire is described in the Measures

section below. Following the control video and questionnaire, the loss videos were presented with directions for participants to rate either their empathic concern or personal distress while viewing the video. Video presentation order and affect-rating pairing were randomized across participants. Neural data was recorded using NIRScout for each video. After each video, participants completed the same questionnaire.

Once participants had completed all stages of the affect rating task, participants were given an option to write a note to each of the 'conversation partners' whose videos they had just watched. This note served as a measure of offered support. Participants were shown a screenshot from each video and were asked if they wanted to send a note to each person. To increase the ecological validity of the task, participants were told that their conversation partners would see the notes. Note task directions were written so as not to explicitly prompt participants to offer support, in order to increase the range of prosociality in the notes (see Appendix B). Following the note task, participants completed the Interpersonal Reactivity Index (IRI), a measure of self-reported trait level empathy, including subscales that specifically look at empathic concern and personal distress (Davis, 1983). Next, participants reported whether they themselves have lost someone close to them, defined by the participant. If participants indicated they had lost a close other, they completed some questions regarding the nature of the loss and their current distress about the loss. Finally all participants completed demographic questions and were debriefed about deception used during the note task.

Measures

All measures are reported in full in Appendix A.

Key Variables.

Shared Experience. Shared experience was determined through participants' answer to the following question: "Have you had a death in your immediate family (e.g., parent, sibling or child), or of someone else very close to you (e.g., dating partner, close friend, etc.)?" Based on their answer participants were assigned to either the shared experience or non-shared experience conditions. As discussed, a key feature of how we defined shared experience is that it is an experience that is both negative and sufficiently uncommon amongst peers that the individual can reasonably assume that most peers do not share the experience. Pretesting using samples from the same undergraduate population determined that loss of a close other meets these requirements.

Similarity. Similarity was measured by two items that were averaged into a composite similarity item. The items were, "How similar do you feel **you** are to your conversation partner?" and "How similar do you feel your **life experiences** are to your conversation partner?" For each video, these items were correlated at r = .62, .75, and .79, respectively. This variable served as a manipulation check that participants who were more similar to the individuals in the loss videos saw themselves as more similar.

Empathic Concern and Personal Distress. Empathic concern and personal distress were measured three ways: as one-item state measures after each video, as trait subscales of the IRI, and implicitly as neural regions associated with continuous, state-level personal distress or empathic concern reported during the video tasks. Trait subscales were reliable (empathic concern a = .81; personal distress a = .81), and thus individual items within each subscale were averaged to create composite measures for both empathic concern and personal distress.

For the one-item state measures, empathic concern and personal distress were positively correlated with each other at .232 (n = 81, p = .037) for the control video, .421 (n = 81, p <

.0001) for the first loss video, and .322 (n = 81, p = .003) for the second loss video. To create variables that represented only the variance unique to each construct, each variable was regressed out of the other to create residual variables of personal distress and empathic concern. These residual variables were used for analyses, and resultant item correlations are reported in Table 1.

Support Offered. Offered support was measured as a binary yes/no answer to the question, "Would you like to write a note to this participant?" for each of the three videos.

Support Quality. Quality of offered support was measured through experimenter coding of the notes participants wrote to the video storytellers. Notes were rated by trained raters for how supportive the note was, how much empathic concern the note-writer seemed to display, and how someone who had been through that experience might feel after reading the note. Factor analysis using maximum likelihood extraction and Varimax rotation determined that these items loaded onto one factor, so mean ratings of the three items were calculated per note to create a measure of support quality ($\alpha = .9$). A high degree of reliability was found between raters. The average measure Intra-Class Correlation, calculated using a two-way random ANOVA measuring consistency, was .966 with a 95% confidence interval from .824 – 1 ($F(1,77) = 29.72$, $p < .00001$). Rating instructions are included in Appendix B.

Neural Data Preprocessing

Data collected with fNIRS was preprocessed using MATLAB R2019A and Homer2. Channels were inspected for motion artifacts and any such artifacts were corrected using Principle Component Analysis. Data were passed through a bandpass filter of 0.005 – 0.5 Hz to exclude machine signal drift. Using the Modified Beer Lambert Law, light intensity values were converted to percent change in oxygenated hemoglobin concentration relative to the scan's

baseline average level. Data were then fit to a canonical hemodynamic response function and converted to Z-scores for analyses.

For spatial localization and visualization of the results, corresponding MNI coordinates of each 10-10 UI external channel position was determined using a probabilistic conversion atlas (Figure 2; http://www.jichi.ac.jp/brainlab/tools.html). Statistical results were calculated for each channel, and then linear interpolation was used to smooth the statistical maps between each channel's MNI location. Images were generated by converting NIRS results to .img/.hdr files using xjview (http://www.alivelearn.net/xjview/), which were then loaded into the Surf Ice brain surface rendering software.

Statistical Analysis

Neural analyses. For analyses locating neural regions associated with personal distress and empathic concern continuous affect ratings, MATLAB R2019A was used.

Key regions for personal distress and empathic concern accessible to fNIRS were interrogated for significant brain-behavior correlations using a permutation-based approach comparing mean correlations to a "null" distribution for each channel of neural data. This null distribution was constructed by repeatedly pairing each channel of each participant's brain data with another, randomly-selected participant's behavioral data. The approach was conservative insofar as it was biased against our hypotheses in two ways.

First, the "null" distribution against which we tested our observed correlations was upward-biased. Specifically, we constructed our null distribution by repeatedly pairing each participant's brain data with another, randomly-selected participant's behavioral data. Critically however, we limited the random pairings to participants who completed exactly the same task

(EC or PD ratings) and watched exactly the same video over exactly the same timecourse. This approach is likely to produce an upward-biased "null" distribution insofar as people who are doing the same thing at the same time tend to have similar psychological experiences, and are known to exhibit similar neural responses (Liu et al., 2017). Under these conditions, pairing one participant's brain with another participant's ratings will tend to yield nonzero correlations (rather than true null correlations) because of the participants' shared visual and psychological experiences. Therefore, any correlations emerging as significant against this "null" distribution may be considered to reflect individual-level brain-behavior correspondences above and beyond the similar experience of participants who were completing the same task.

Second, in addition to our "null" distribution being upward-biased, it was also biased toward producing more extreme correlation values by chance, making it more difficult to reject the null hypothesis. Specifically, in limiting our random participant pairings to those who watched the same video (rather than sampling across both videos), we selected the shorter of the two stimuli. This translates to a null distribution that "expects" large correlations to emerge by chance with some regularity. Therefore, any true brain-behavior correlation emerging as significant would have to exceed this biased "expectation."

After preprocessing, each channel was mean-smoothed using a 10-second neighborhood, resampled to the same frequency as the behavioral data (one-second timepoints), z-scored, and cropped to the same length as the behavioral data. Behavioral ratings were convolved with a canonical hemodynamic response function and z-scored prior to being correlated with the brain data.

Visual inspection of the data revealed that a subset of participants failed to move the mouse at all for reporting moment-by-moment affect ratings until well into the task. Participants

who were unresponsive for more than the first 20% of the video were withheld from analysis (and from the bootstrapped null distributions; six for personal distress analysis, four for empathic concern analysis). One additional participant was removed as a statistical outlier because their behavioral ratings were erratic (variance 3 standard deviations above the mean). In order to focus on the emotional dynamics of participants' experiences, we removed the relatively static first 25 seconds of each timecourse, as well as the final five seconds (which can reflect participants' awareness of a task coming to its end and planning responses to upcoming questions).

Separate null distributions of one thousand samples each were constructed for each channel of interest per participant using the same procedures as those used in the true analysis. As a result, each channel served as its own statistical control, providing null distributions that retained the statistical idiosyncrasies of the specific brain region being interrogated.

Behavioral analyses. Behavioral analyses were conducted using IBM SPSS Statistics 20. To look at the impact of video type and personal experience with loss (i.e., shared experience vs. non-shared experience) on personal distress and empathic concern, two-way mixed design analyses of variance were conducted. Chi Square analyses were conducted to determine whether shared experience participants chose to write notes at a different rate than non-shared experience participants. Binary logistic regression was used to determine impact of personal distress and empathic concern on the likelihood of a participant choosing to offer support in the form of a written note. T-tests were conducted to determine the impact of video and personal experience with loss on quality of support offered in notes to the storytellers, and multiple regression analyses were conducted to examine the relationship between support quality and the empathic concern and personal distress.

Some participants were missing a type of data, such as continuous affect ratings, portions of self-report data, or some neural data, but were kept in other analyses, so Ns varied across analyses.

Results

Similarity

Descriptive statistics of the measures and inter-item correlations are reported in Table 1. Participants' self-reported similarity to the storytellers in the videos was assessed as a manipulation check that participants who had lost a close other were in fact recognizing themselves as more similar to the loss video storytellers than participants who had not experienced such a loss.

A two-way mixed ANOVA revealed a significant interaction of video type and participant experience with loss, such that for the control video, participants reported similar levels of similarity regardless of participant experience (shared experience $M = 4.13$, $SD = 1.38$; non-shared experience $M = 4.48$, SD = 1.4), but for the loss videos, participants who shared the experience of loss (video 1 $M = 4.83$, SD = 1.63; video 2 $M = 5.04$, SD = 1.68) reported significantly more similarity than non-shared experience participants (video 1 $M = 3.33$, SD = 1.61; video 2 $M = 3.13$, SD = 1.5), $F(2,156) = 17.47$, $p < .00001$ (see Figure 1). Thus, participants who were less similar to the loss storytellers did in fact recognize that they were less similar, showing that the manipulation was effective.

Overall, similarity was significantly, positively correlated with empathic concern and personal distress for both the control video and loss videos, meaning the more similar participants felt they were to a storyteller, the more empathic concern and personal distress they felt in response to that storyteller's story (see Table 1 for inter-item correlations).

Neural Correlates of Continuously-Rated Empathic Concern and Personal Distress

After correcting for multiple comparisons using false discovery rate, three channels of neural data emerged as significantly correlated with participants' ratings of personal distress (channel 33 r = .14, p = .03; channel 34 r = .12, p = .01; channel 39 r = .1, p = .046). Together these channels correspond to a region encompassing a portion of SMA and premotor cortex, a region found to be associated with personal distress in fMRI research. This region did not exhibit significant correlations with empathic concern ratings. Significant correlations between personal distress continuous affect ratings and neural data are shown in Figure 2.

No regions were found to be significantly correlated with empathic concern continuous affect ratings.

Predicting Empathic Concern and Personal Distress from Shared Experience

Two-way mixed design ANOVAs were conducted to determine how participant experience with loss impacts self-reported empathic concern and personal distress for the control video compared to the videos about losing a loved one. For empathic concern (unstandardized residuals after removing variance shared with personal distress), there were no main effects of participant experience with loss or video, and no interaction between participant experience and video. Results are shown in Figure 3.

For personal distress (unstandardized residuals after removing variance shared with empathic concern), results showed a significant interaction between participant experience with loss and video, such that, when watching the loss videos, participants who had experienced loss (video 1 M = .28, SE = .28; video 2 M = .25, SE = .31) reported significantly more distress than participants with no experience of loss (video 1 M = -.31, SE = .26; video 2 M = -.25, SE = .2), but after watching the control video there were no differences for participants with experience

with loss (M = -.14, SE = .23) and participants with no such experience (M = .14, SE = .28), $F(2,156) = 3.01$, $p < .05$ (see Figure 4). No main effects were found.

Offered Support and Shared Experience

Tallies for support offered by condition per video can be found in Table 2. Chi square analyses were conducted to determine whether shared-experience participants differed from non-shared experience participants in rates of offered support. For the control video, there was a marginally significant relationship between offered support and participant experience with loss, such that shared experience participants were marginally more likely to offer support, χ^2 (1, N = 81) = 3.39, p = .07. Matching our alternate hypothesis, there was no significant relationship between offered support and participant experience for both Video 1 (χ^2 (1, N = 80) = 1.87, p = .67) and Video 2 (χ^2 (1, N = 80) = 1.21, p = .27), meaning that shared experience participants were offering support at similar rates to non-shared experience participants.

Offered Support, Empathic Concern, and Personal Distress

Binary logistic regressions were conducted to find whether personal distress and empathic concern predicted likelihood of offering support for each video. Participants' decision of whether or not to offer support to a specific storyteller was regressed on self-reported empathic concern and personal distress, reported directly after each video. Residual variables were used for both empathic concern and personal distress. For the control video, participants higher in self-reported empathic concern were significantly more likely to offer support when holding personal distress constant, b = .6, SE = .25, $Wald$ = 5.83, p = .02. This result was expected, as was the result that personal distress did not predict offered support for the control video when holding empathic concern constant, b = -.15, SE = .28, $Wald$ = .29, p = .59. The

interaction between empathic concern and personal distress was also not a significant predictor of offered support, b = .28, SE = .22, $Wald$ = 1.58, p = .21.

Looking at the first experimental video, participants higher in self-reported empathic concern were marginally significantly more likely to offer support when holding personal distress constant, b = .38, SE = .21, $Wald$ = 3.27, p = .07. Personal distress did not predict offered support for the control video when holding empathic concern constant, b = -.17, SE = .15, $Wald$ = 1.27, p = .26. The interaction between empathic concern and personal distress was also not a significant predictor of offered support, b = -.03, SE = .07, $Wald$ = .25, p = .62.

For the final experimental video, participants higher in self-reported empathic concern were significantly more likely to offer support when holding personal distress constant, b = 1.13, SE = .29, $Wald$ = 14.89, p = .0001. Unique from both the control video and the first experimental video, participants higher in personal distress after viewing this video were significantly more likely to offer support when holding personal distress constant, b = .45, SE = .18, $Wald$ = 6.46, p = .01. The interaction between empathic concern and personal distress was not a significant predictor of offered support, b = .00, SE = .12, $Wald$ = 0, p = .99.

Correlates of Support Quality

Since writing a note was optional, ns were too low to conduct a mixed ANOVA looking at participant history and note quality for each video. Instead, t-tests were conducted. As expected, for the control video there were no significant differences between note support quality for participants with experience with loss (M = 3.47, SD = .7) and participants with no experience with loss (M = 3.51, SD = .79); t(18) = -.12, p = .9. For a composite measure of support quality across both experimental videos, there was a significant difference in scores for

participants with experience with loss (M = 3.55, SD = .6) and participants with no experience with loss (M = 3.02, SD = .67); t(41) = 2.73, p = .009 (see Figure 5).

Multiple regression analyses were conducted to examine the relationship between support quality and the empathic concern and personal distress residuals. The multiple regression model with two predictors showed that empathic concern and personal distress accounted for 21% of the variance in note support quality (adjusted R^2 = .21, F(2,40) = 5.38, p = .009. Both the empathic concern residual (β = .48, p = .004) and personal distress residual (β = .39, p = .02) were significant, indicating that, after controlling for personal distress, participants with greater empathic concern provided higher quality support in their notes, and after controlling for empathic concern, participants with higher scores of personal distress also provided higher quality support.

Discussion

Neural correlates of empathic concern and personal distress. This study identified a region associated with personal distress continuous affect ratings, namely a region with activation in the left SMA/premotor cortex. Using fMRI, Ashar et al. (2017) also found left premotor cortex as a region preferentially associated with continuous personal distress ratings, and this finding is supported by meta-analyses in which premotor regions were associated with observation of actions, sensations, and emotional facial expressions (Keysers et al., 2010; Molenberghs et al., 2012). Additionally, Gallese et al (2004) identified a similar premotor region as part of the mirror network of the brain, which allowed for the experiential understandings of others' actions and emotions.

This study identified no regions uniquely associated with empathic concern. In the fMRI study by Ashar et al. (2017), regions preferentially associated with empathic concern were generally more medial and/or ventral than where fNIRS can reliably obtain signal, excluding a portion of vmPFC at the edge of where the NIRx cap reaches. Future replications could confirm whether these results were due to noise from measurement error or if empathic concern cannot be reliably measured using fNIRS .

These findings extend previous research identifying markers for empathy-related emotions and are the first findings extending such work into fNIRS neuroimaging (Ashar et al., 2017). Locating a region specific to personal distress allows future fNIRS studies to look in an a-priori region for activation related to personal distress. Combined with fNIRS' potential for flexibility and ecological validity, this finding can be used in future research to develop a deeper understanding of the role personal distress plays in motivating prosocial behavior in complex social situations, such as face-to-face conversations.

Personal distress, prosocial behavior, and shared experience. This study is the first to directly test how shared experience impacts both empathic concern and personal distress, and demonstrates that, compared to individuals with no experience of loss, those who have shared the experience of losing a loved one feel similar levels of empathic concern but more personal distress when observing someone talk about their own loss.

Additionally, this study demonstrated that individuals who have experienced a similar loss as a storyteller, while feeling greater personal distress, are on average no less likely to offer support to the storyteller, and the support they offer is higher quality than support offered by individuals who have never experienced the loss of a loved one. Finally, this study demonstrated

that personal distress does have a unique role in motivating prosocial behavior, regardless of empathic concern.

These findings have important implications for how we seek and provide support for those currently in distress. As discussed, personal distress is less consistently related to prosocial behavior, so if individuals who have shared a negative experience feel more personal distress, they may be less likely to provide support. Yet individuals who are currently experiencing a distressing event may be more inclined to *seek* support from others who have shared the experience, and may view that support as more helpful (Barnes & Lieberman, manuscript; Dakof & Taylor, 1990.; Hodges et al., 2010). In a study of women who had lost close relatives, Barnes and Lieberman (manuscript) experimentally manipulated whether participants believed that support-givers had themselves lost a close relative, and found that participants rated support from those who they believed had been through a similar experience as more helpful than support from those they believed had no personal experience with loss.

In their study of pregnant mothers, Hodges, et al. (2010) asked new mothers, pregnant women, and women who had never been pregnant to write letters to women participants who were pregnant. Those participants then rated the letters for how understood they felt by the person writing the letter. Pregnant participants felt most understood by new mothers, and least understood by women who had never been pregnant. This effect appeared to be driven by letter-writers spontaneously disclosing whether they had ever been pregnant. In an inductive interview study of cancer patients' perceptions of support they had received, 27% of patients spontaneously discussed the way other current or former cancer patients had a "special understanding" of the participant's experiences, due to shared experience (Dakof & Taylor, 1990). Many participants in this study also felt those with similar experiences were helpful due

to the useful information they could provide and the way these support-givers functioned as role models for the participant.

To measure support quality, this study used trained experimenter raters. Considering the role of shared experience, future research should explore how individuals who have experienced loss rate the quality of support offered. Additionally, future research could address whether higher-quality support from individuals who have shared a painful experience predicts any positive outcomes for individuals currently in distress, such as how those individuals feel after receiving the support, or the likelihood that they will pursue further support in the form of mental health services, online support groups, or connecting with existing social support figures.

On the side of the empathizer, future research can explore how providing support impacts an empathizer's mood and own healing process. While individuals who have shared a painful experience may feel more personal distress observing someone talking about their own painful experience, that may not necessarily cause negative downstream effects for the empathizer, particularly if it does not decrease the likelihood that they will offer support. Previous research has shown that providing social support to others has positive benefits for one's own well-being and emotion regulation, particularly for individuals who have experienced suffering (Doré, Morris, Burr, Picard, & Ochsner, 2017; Staub & Vollhardt, 2008). Opportunities for individuals to provide support for others who have experienced similar pain may then provide positive benefits for both empathizer and empathy recipients.

Tables

Table 1.

Means, Standard Deviations, and Inter-Item Correlations Between Continuous Variables.

	Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	*M*	*SD*
1.	Similarity – Control	1													4.31	1.39
2.	Felt EC – Control	.61***	1												0	1.36
3.	Felt PD – Control	.19	-.23	1											0	1.61
4.	Support Quality – Control	.13	.1	-.003	1										3.48	.71
5.	Similarity – Loss 1	.19	.08	.07	.22	1									4.07	1.77
6.	Felt EC – Loss 1	.01	.112	-.222	.27	.3**	1								0	1.26
7.	Felt PD – Loss 1	.15	.01	.39***	.35	.41**	-.42***	1							0	1.74
8.	Support Quality – Loss 1	-.01	-.02	-.13	.29	.4*	.02	.15	1						3.28	0.75
9.	Similarity – Loss 2	.09	.11	.016	.2	.53***	.25*	.21	.45**	1					4.09	1.85
10.	Felt EC – Loss 2	-.08	.03	-.24*	.38	.26*	.57***	-.12	.19	.3**	1				0	1.40
11.	Felt PD – Loss 2	.27*	.13	.49***	.26	.33**	-.14	.592***	.27	.4**	-.32**	1			0	0.08
12.	Support Quality – Loss 2	.12	.13	-.03	.08	.28	.36*	.03	.13	.19	.16	.14	1		3.43	.77
13.	Total Support Offered	.21	.42*	-.14	.66*	-.49	.4*	.1	.46*	.36*	.24	.32	.42*	1	1.06	1.04

Note. *$p \leq .05$, **$p \leq .01$, ***$p \leq .00$. EC and PD items are residuals.

Table 2.

Offered Support tallies, by video and participant experience with loss

	Variable		Control	Video 1	Video 2
1.	Shared experience	Yes	14	13	22
		No	26	26	17
2.	Non-shared experience	Yes	7	17	13
		No	34	24	28

Figures

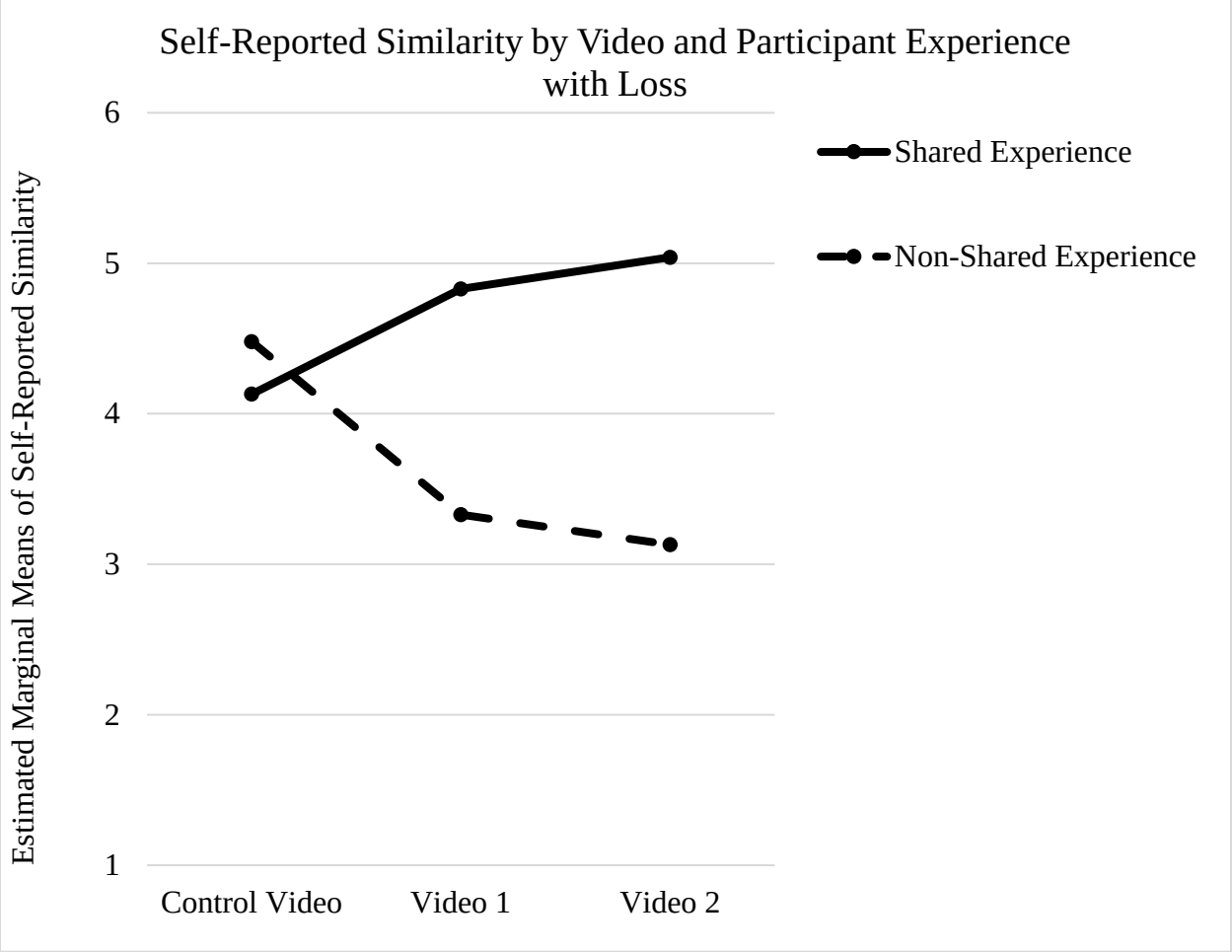


Figure 1. Manipulation check of similarity shows significant interaction, in which participants who shared the experience of loss with the storytellers in the loss videos reported themselves as more similar than participants with no experience with loss.

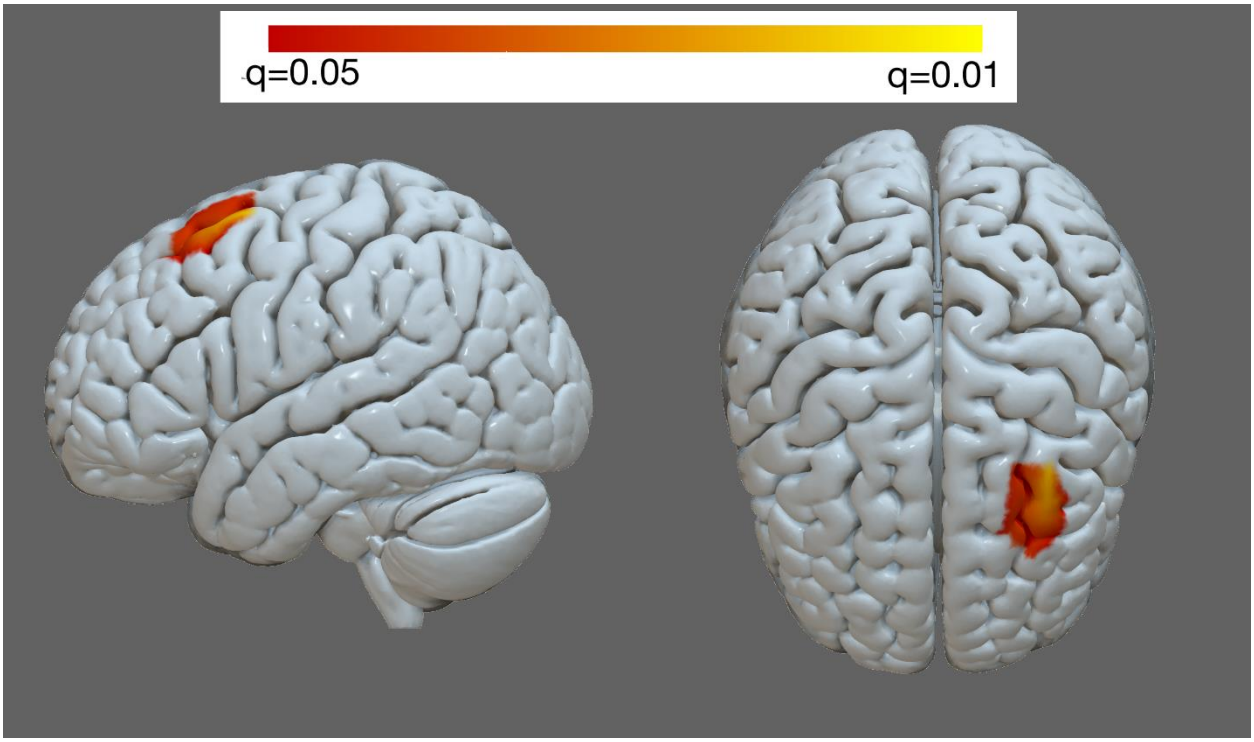


Figure 2. Neural activation significantly correlated with personal distress continuous affect ratings. Significant region corresponds with a portion of left supplementary motor cortex and premotor cortex.

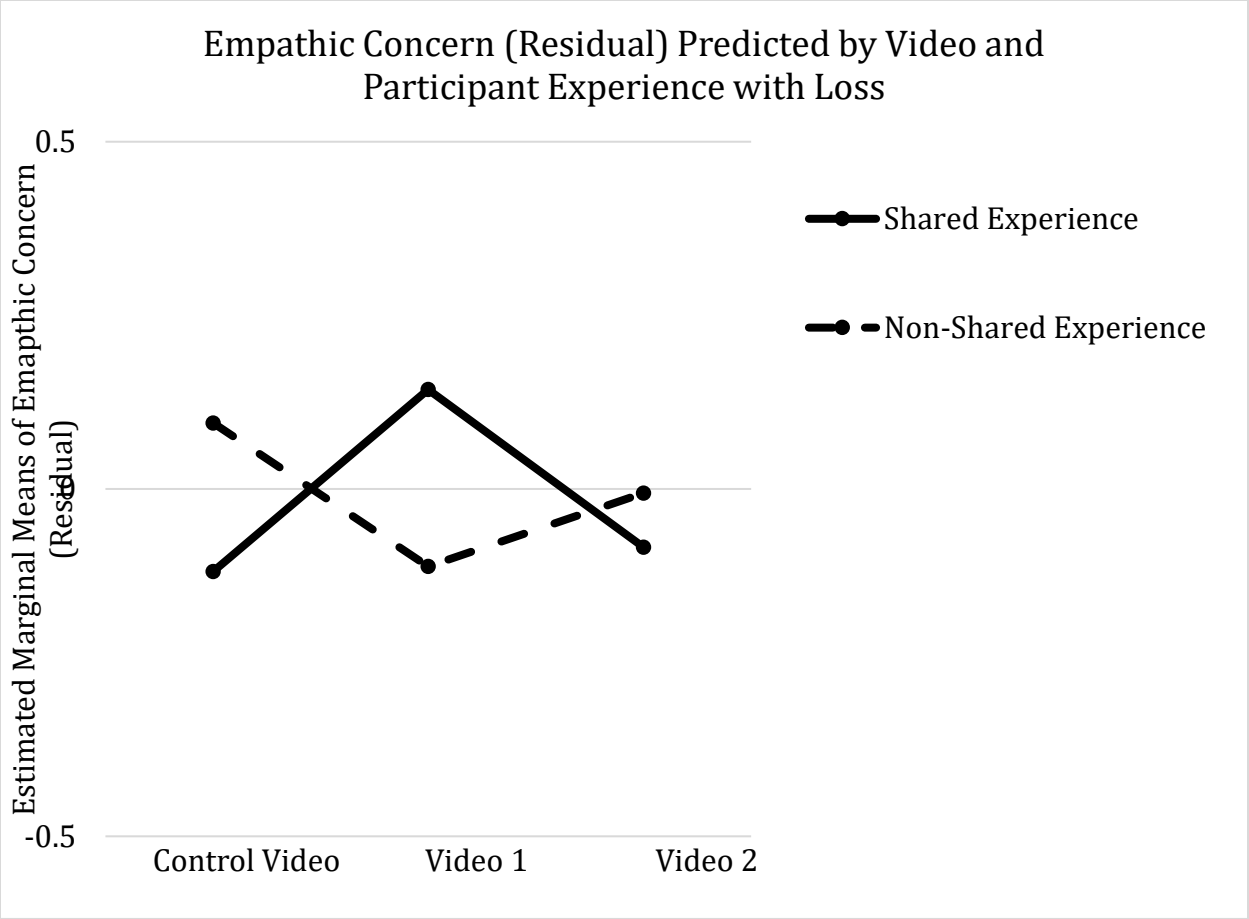


Figure 3. No significant differences were found between groups or across videos.

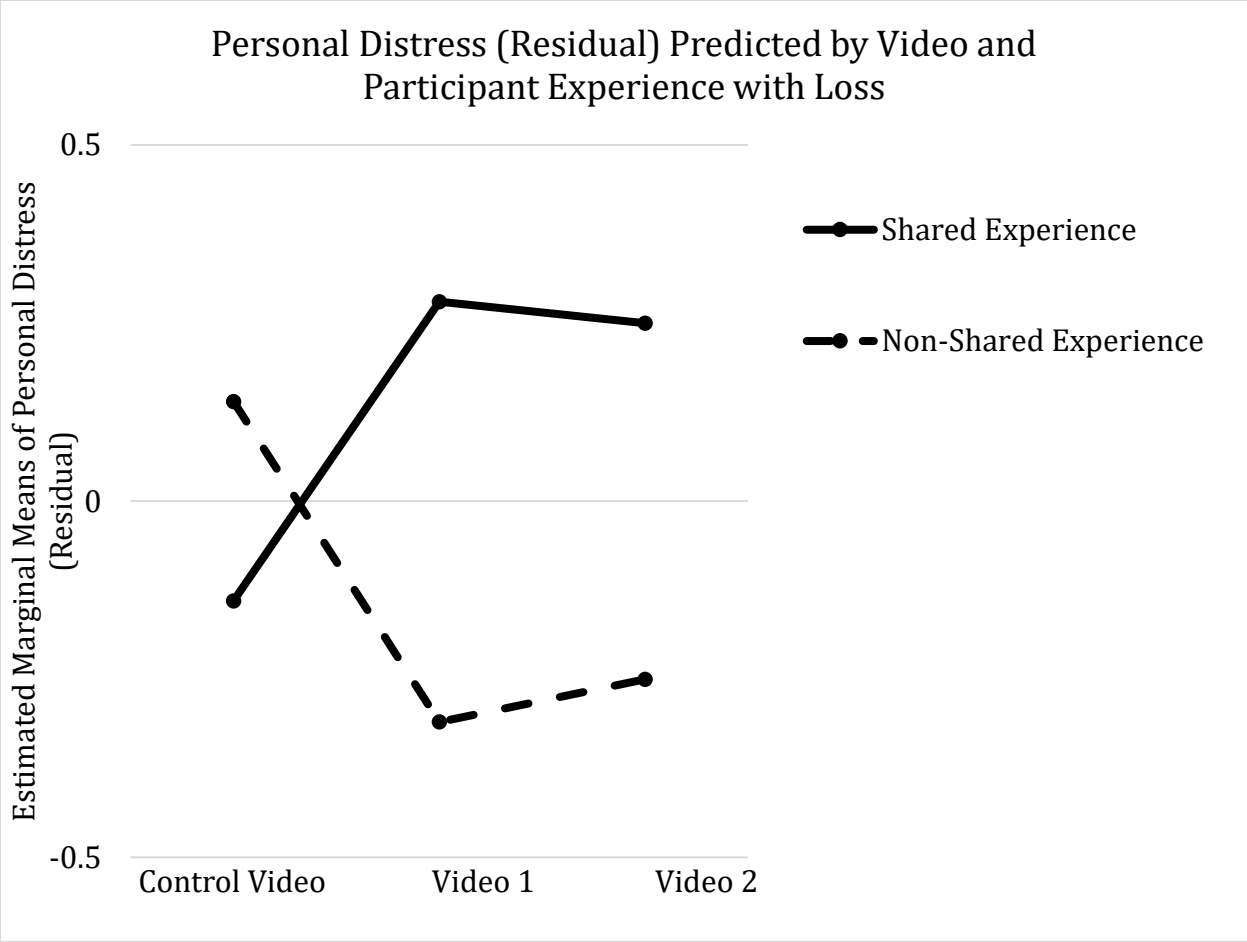


Figure 4. Significant interaction between video and participant experience with loss, such that participants who had experienced loss reported more personal distress (residual) than participants with no experience with loss, but only for the loss videos.

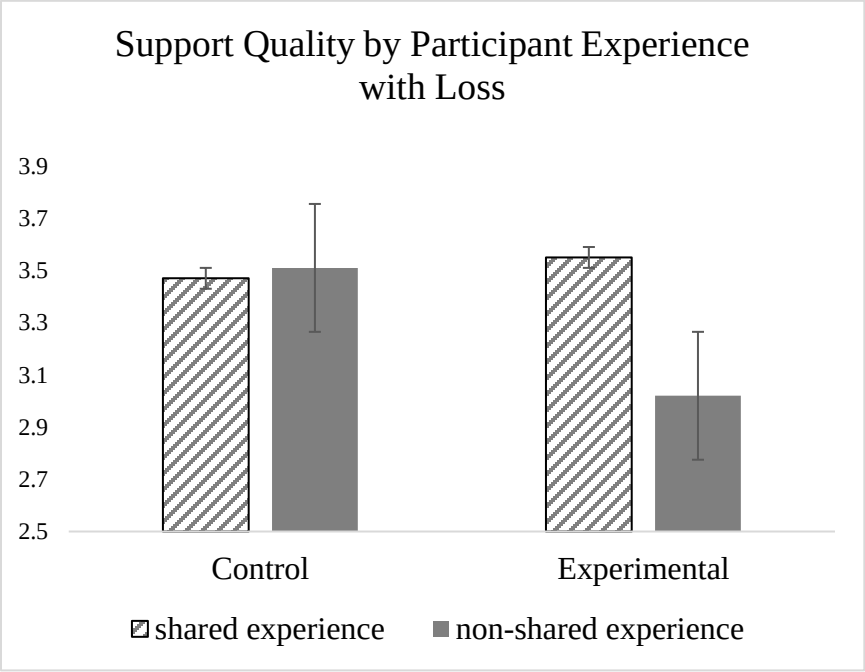


Figure 5. Support Quality by Participant Experience with Loss. Participants who had shared the experience of loss wrote more supportive notes for loss videos, but not for control videos.

Appendix A

Participant Survey

Empathic Concern vs. Personal Distress Training

The task we will be asking you to complete involves viewing some short videos and rating specific emotions you feel while watching the videos. Before you do this, we'd like to ensure that it is clear what we mean by the emotions we'd like you to rate. Please continue here to read our definitions. Read carefully! We'll be asking you a few questions afterward.

For this task, you will be rating your emotions moment-by moment as they change during the video. There are two potential emotions that we may ask you to rate: empathic concern and personal distress.

Definitions:

Empathic concern: an emotional response of concern and/or compassion caused by knowing someone else is in pain or in need. We feel bad *for* the other person - we share their emotions in that we understand how they feel, but it's clear to us that the painful things aren't happening directly to us. When we feel empathic concern, we may want to go toward the person in need, perhaps to offer help or emotional support.

Personal distress: an emotional response of distress, anxiety, and/or uneasiness caused by knowing someone else is in pain or in need. We feel bad *with* the other person - we share their emotions so much that it feels almost as if the painful things are happening to us as well. When we feel personal distress, we may want to offer help or emotional support, or we may want to go away from the person in need, perhaps to calm ourselves down so we can later help.

Important: it is both **possible and normal to feel both emotions at the same time**. When we see someone else in pain we often feel anxious while also wanting to help. These two emotions are not so much opposites as they are two parts of the same experience, although you may feel one more than the other at any given moment. Please keep this in mind as you rate the following videos.

In your own words, how would you define **empathic concern**?

_____
_____
_____
_____

In your own words, how would you define **personal distress**?

_____
_____
_____
_____

Please select the emotion that is associated with the following words:

	empathic concern	personal distress
uneasy	○	○
compassionate	○	○
overwhelmed	○	○
anxious	○	○
sympathetic	○	○
feeling bad with	○	○
feeling bad for	○	○

Can we feel both of these emotions in response to the same situation, or do we just feel one or the other?

- ○ Both at once
- ○ One or the other

Conversation Partner Questions

The following questions are about your first "conversation partner," the person whose video you just watched.

How similar do you feel **you** are to your conversation partner?
Not at all (1)

- ○ (2)
- ○ (3)
- ○ Moderately (4)
- ○ (5)
- ○ (6)
- ○ Very much (7)

How similar do you feel your **life experiences** are to your conversation partner?

- ○ Not at all (1)
- ○ (2)
- ○ (3)
- ○ Moderately (4)
- ○ (5)
- ○ (6)
- ○ Very much (7)

How **close** do you feel to your conversation partner?

- ○ Not at all (1)
- ○ (2)
- ○ (3)
- ○ Moderately (4)
- ○ (5)
- ○ (6)
- ○ Very much (7)

After watching the video, how much **empathic concern** do you feel for your conversation partner?

- ○ Not at all (1)
- ○ (2)
- ○ (3)
- ○ Moderately (4)
- ○ (5)
- ○ (6)
- ○ Very much (7)

After watching the video, how much **personal distress** do you feel?

- ○ Not at all (1)
- ○ (2)
- ○ (3)
- ○ Moderately (4)
- ○ (5)
- ○ (6)
- ○ Very much (7)

How much do you **like** your conversation partner?

- ○ Not at all (1)
- ○ (2)
- ○ (3)
- ○ Moderately (4)
- ○ (5)
- ○ (6)
- ○ Very much (7)

How **warmly** do you currently feel toward your conversation partner?

- ○ Not at all (1)
- ○ (2)
- ○ (3)
- ○ Moderately (4)
- ○ (5)
- ○ (6)
- ○ Very much (7)

How **successful** do you feel you were at implementing the training you were given before watching the videos?

- ○ Not at all (1)
- ○ (2)
- ○ (3)
- ○ Moderately (4)
- ○ (5)
- ○ (6)
- ○ Very much (7)

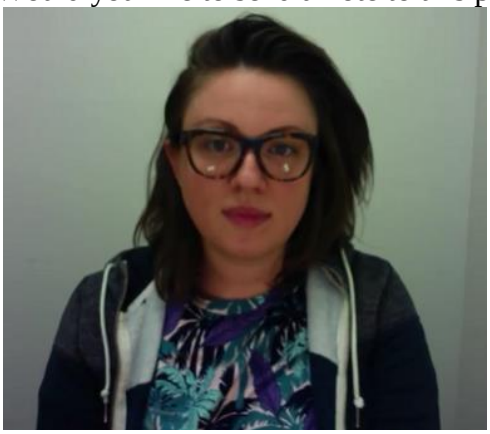
Do you know this conversation partner from outside the study?

- ○ Yes
- ○ No

Note-Writing Task

The videos you watched were recorded by other participants who are also UCLA students. If you like, you can send any or all of them a short message. Once the study is complete, we will collect these messages – with no identifying information – and deliver them to the participant.

Would you like to send a note to this participant?

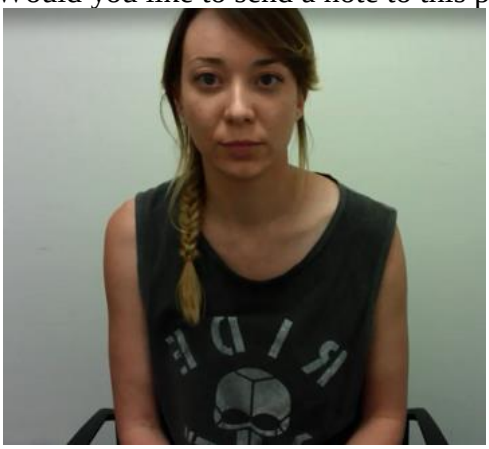


- ○ Yes
- ○ No

Please write your note here. Remember that these notes will be anonymous, so please do not include any identifying information.

_____
_____
_____
_____

Would you like to send a note to this participant?



- Yes
- No

Please write your note here. Remember that these notes will be anonymous, so please do not include any identifying information.

_____
_____
_____
_____

Would you like to send a note to this participant?

- Yes
- No

Please write your note here. Remember that these notes will be anonymous, so please do not include any identifying information.

_____
_____
_____
_____

Prior Experience with Loss Questions

Have you had a death in your immediate family (e.g., parent, sibling or child), or of someone else very close to you (e.g., dating partner, close friend, etc.)?

- Yes
- No

To what extent do you currently feel distress about the death of your immediate family member?

- Not at all (1)
- (2)
- (3)
- Moderately (4)
- (5)
- (6)
- Very Much (7)

Have you undergone any form of therapy, counseling or group counseling to address distress about your loss?

- Yes
- No

How long ago did the death occur? If less than 1 year, enter a 0 for "Years." If 1 year or greater, round to closest year and enter 0 for "Months."

- Years _____
- Months _____

Was the death sudden, or more drawn out (e.g., an illness)?

- Sudden
- Drawn out
- Other: _____

Appendix B

Note Support Quality Coding Scheme

of words in note: _____

Did the participant disclose whether they have experienced something similar to the person in the video?

- ○ Yes
- ○ No
- ○ Unsure - explain: _____

Q561 How much empathic concern do you think this participant showed for the person in the video?

- ○ None at all
- ○ A little
- ○ A moderate amount
- ○ A lot
- ○ A great deal

How supportive was the note?

- ○ Not supportive at all
- ○ A little supportive
- ○ Moderately supportive
- ○ Pretty supportive
- ○ Extremely supportive

If someone who had experienced a [bad roommate situation/a loss of a close other] were to read this note just after talking about their situation, how do you think they would feel?

- ○ Much worse
- ○ Moderately worse
- ○ Slightly worse
- ○ About the same
- ○ Slightly better
- ○ Moderately better
- ○ Much better

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Paper 2

Interpersonal Neural Dynamics of Shared Experience

Abstract

The current study examined neural synchrony between an empathy target 'storyteller' and participants who have experienced a similar distressing occurrence as the storyteller (shared experience participants) compared to those with no experience with the distressing occurrence (non-shared experience participants). In brain regions related to personal distress, shared experience participants exhibited significantly greater neural synchrony with the storyteller than non-shared experience participants. Shared experience participants also reported feeling more personal distress in response to the story, compared to non-shared experience participants, but the groups did not differ on self-reported empathic concern. Additionally this study tested a potential intervention for reducing personal distress without also reducing empathic concern. The intervention, a short mindful attention training, was found to reduce personal distress compared to a control condition, while empathic concern remained similar across conditions. Implications for empathy and social neuroscience research are discussed, as are implications for support providers.

Interpersonal Neural Dynamics of Shared Experience

In empathy research, participant history with painful emotional experiences has been rarely addressed, especially in terms of neuroscience research. While some behavioral studies have shown that empathizers who have been through a similar experience as the empathy target may feel more general empathy (Barnett, Tetreault, & Masbad, 1987; Eklund et al., 2009; Hodges et al., 2010) and more implicit personal distress (Barnett, 1983), no neuroimaging studies have explored the role of shared experience in empathy for emotional pain. Neuroimaging research on empathy for physical pain sometimes uses a 'shared experience' condition in order to locate overlap between felt pain and observed pain, and meta-analyses of these studies have found such overlap in sensorimotor regions such as the supplementary motor area (SMA), promotor cortex, and somatosensory cortices (Bufalari & Ionta, 2013; Decety & Lamm, 2006). Overall activation in these regions are also related to the personal distress aspect of empathy for emotional experiences (Ashar et al., 2017), while overall activation in a region of the superior parietal lobule (SPL) is found to be inversely related to observing distressing stimuli (Benuzzi, Lui, Duzzi, Nichelli, & Porro, 2008). Previous research in this dissertation also established that shared experience in the emotional pain of losing a loved one is associated with greater self-reported personal distress.

What has not been established is whether *interpersonal* overlap in regions related to personal distress would increase for empathizers who have experienced a similar pain as the target of empathy; in other words, do personal distress regions in empathizers' brains show stronger correlations with the empathy target's brain when empathizers have been through a similar painful experience, compared to empathizers who have no personal history with the painful experience? This is one of the primary objectives of the current investigation.

Recent research on interpersonal neural synchrony provides some evidence that increased synchrony is related to both interpersonal physical coordination (Novembre, Knoblich, Dunne, & Keller, 2017) and prosocial behavior (Hu, Hu, Li, Pan, & Cheng, 2017). Novembre et al. (2017) used transcranial alternating current stimulation to artificially increase interpersonal neural synchrony, which then predicted greater interpersonal coordination during a finger-tapping task. When using fNIRS to measure spontaneous interpersonal neural synchrony, Hu et al. (2017) found that greater synchrony between participant partners during a physical coordination task predicted greater subsequent prosociality between partners. Even just perceived physical synchrony may relate to greater empathy (Koehne, Hatri, Cacioppo, & Dziobek, 2016). Using a virtual 'partner' to be either in or out of sync with a participant's finger-tapping movement, Koehne et al. (2016) found that participants who perceived their partner as more in sync with their finger movement scored higher on subsequent objective measures of general empathy.

If physical overlap can increase neural synchrony and predict empathy, then overlap in emotional experiences may also relate to neural synchrony and empathy, particularly personal distress.

Reducing personal distress. Personal distress, whether self-reported or measured as increased synchrony with a distressed storyteller, by its very nature is aversive and is generally less likely to lead to prosocial behavior than empathic concern, a more other-oriented empathic emotion (Batson, O'Quin, et al., 1983). As such, efforts have been made to reduce personal distress in empathizers using emotion regulation strategies such as suppression, which involves inhibiting emotion expressions, and cognitive reappraisal, which involves changing construals about the emotional stimuli and situation (Adams & Riggs, 2008; López-Pérez & Ambrona, 2015). These strategies have had mixed results, with suppression generally being ineffective at

reducing personal distress, while cognitive reappraisal seems to be an effective strategy for reducing personal distress at others' suffering (López-Pérez & Ambrona, 2015).

However, due to their more global effects on emotions, emotion regulation strategies can in fact reduce both personal distress *and* the amount of empathic concern people feel toward others (Cameron & Payne, 2011; Haque & Waytz, 2012; Hodges & Biswas-Diener, 2007). In their review of empathy and emotion regulation, Hodges and Biswas-Diener note that cognitive reappraisal can sometimes take the form of dehumanization, in which the perceiver may reframe the victim as less like themselves. This dehumanization reappraisal technique can be seen in military personnel, who may initially feel empathy for non-military victims of war, but then may reframe such events as "collateral damage" (Hodges & Biswas-Diener, 2007), and in medical professional, who report less empathic concern for their patients the more they try to reframe patients as 'mechanistic bodies' in order to reduce personal distress (Haque & Waytz, 2012).

Mindful attention. While emotion regulation has shown mixed results with regards to reducing personal distress without also reducing empathic concern, another potential mechanism for reducing personal distress is mindful attention. Mindfulness and acceptance are concepts drawn from Buddhist philosophy and practices, and have received recent attention from researchers in psychology and neuroscience. Mindfulness is defined as having two parts: 1) a self-regulation of attention, such that one remains focused on immediate experience, and 2) acceptance, in which one approaches immediate experience with a curiosity and willingness to accept whatever emotion or event one experiences, regardless of how negative or unwanted that emotion or experience is (Hayes & Feldman, 2004). Mindfulness has been shown to reduce intensity of physical pain, which shares neural circuitry with social pain (Eisenberger, 2012; Zeidan, et al., 2011). Mindfulness may be seen as a form of secondary emotion regulation, in that

one is regulating the emotional response to experiencing emotion. For example, an individual may experience sadness as the result of depression, and then may experience frustration or shame for feeling sad. Therapies such as Acceptance and Commitment Therapy (Hayes et al., 2006) target this secondary emotional response. The goal is not to change one's initial emotion, but rather to accept that emotion without fighting against it. As such, mindful attention could be particularly effective in reducing personal distress, which is distress at sharing a distressing emotion with another. Additionally, mindfulness is related to theories of interdependence, in that it encourages less focus on the self and more focus on how one can benefit others, and thus may be useful for improving the interaction between empathizer and empathy target (Kelley & Thibaut, 1978; Ozawa-de Silva, 2015).

On a dispositional level, mindfulness and empathy seem to be related (Thomas & Otis, 2010). Thomas and Otis (2010) believe mindfulness may increase a person's capacity for empathy while protecting that person from personal distress. The view is supported by evidence from their correlational study of therapists and dispositional mindfulness and empathy: those therapists who reported higher dispositional mindfulness also reported significantly lower personal distress, as measured in a dispositional empathy scale (Thomas & Otis, 2010). Mindfulness was positively related to compassion satisfaction, which was defined as feelings of fulfillment coming from empathizing and helping others. Similarly, Beitel, Ferrer and Cecero (2005) found self-reported dispositional mindfulness to be positively correlated with self-reported empathy but negatively correlated with personal distress.

While these studies are correlational, research on training interventions could help establish the usefulness of mindfulness in specific, empathy-inducing situations. In their review of research on mindfulness and empathy, Block-Lerner and colleagues make the case that

mindfulness training may be an effective tool to increase empathy between couples (Block-Lerner, Adair, Plumb, Rhatigan, & Orsillo, 2007). In particular, Mindfulness-Based Stress Reduction and Mindfulness-Based Cognitive Therapy, two common mindfulness interventions, may help individuals build mindfulness "tools" so that, when faced with an empathy-inducing situation, those individuals are more likely to utilize those tools and listen in an empathic, non-judgmental way.

A major drawback of both Mindfulness-Based Stress Reduction and Mindfulness-Based Cognitive Therapy are that they are time and effort-intensive, requiring numerous training sessions. One recent study has adapted more intensive mindfulness trainings into a short, single-session mindful attention training that has been shown to be effective at reducing nicotine cravings in smokers (Westbrook et al., 2013). Because of its brevity and effectiveness, this training showed potential as an intervention in empathy situations to reduce personal distress without also reducing empathic concern, and so was adapted for use in the current study.

Current Study and Hypotheses

Two primary goals guided this study. First, we aimed to discover how individuals who have been through a similar experience to a storyteller differ from those who have not been through that experience in terms of neural synchrony with the storyteller. We hypothesized that individuals who have shared an experience would show greater synchrony with the storyteller than individuals who have not shared the experience, particularly in regions related to personal distress.

Second, this study aimed to test a potential intervention for reducing personal distress, mindful attention, for both shared experience and non-shared experience participants. We hypothesized that the mindful attention training would be more effective than a control training

at decreasing distress when observing the storyteller in distress. We also hypothesized that the intervention would reduce distress without also reducing empathic concern. Since shared experience participants have been established to report greater personal distress, we developed an exploratory hypothesis to see if a mindful attention intervention had different results for shared experience vs. non-shared experience participants.

Method

Participants

Participants were undergraduate students at the University of California, Los Angeles. Only women (n = 115, *M* age = 20.6, SD = 2.97) were recruited for the study. Participants were 27% White, 0.9% Black, 14.8% Latinx, 43.5% Asian, and 13.9% multiracial. Shared experience participants (who had lost a close other to a death) were 63.5% of the sample (N = 73), while non-shared experience participants were the remaining 36.5% of the sample (N = 42). 51.3% of participants completed the control condition (N = 59) while 48.7% of the participants completed the mindful attention intervention (N = 55).

Materials

Imaging technology. This study used the NIRScout imaging unit from NIRx (nirx.net/nirscout) with 32 light sources and 32 light detectors, creating 108 channels of data. This allowed a cap configuration covering the majority of the cerebral cortex and a spatial resolution of around 1cm. Four elastic head caps ranging in size were used in order to affix the light sources and detectors to participants' heads. We used the 10-10 UI external positioning system to standardize spatial positioning across participants**.** Light intensity data was collected at

wavelengths of 760 and 850nm with a sampling rate of 1.95 Hz, or one full set of samples every .5128 seconds.

Video stimuli. Video stimuli were collected in an initial data wave from 22 undergraduate women participants (M age = 19.77, SD = 2.41) who had experienced the death of someone close to them within the last 3 years. For this study, all three videos needed to come from the same participant, in order to control for differences in neural synchrony due to features of the storyteller. Participants were asked to record videos, in random order, about a time they received a poor grade, a bad breakup they experienced, and a time someone close to them died. Finally participants were asked to record a video about a time someone was kind toward them, to improve their mood after the negative experience videos. If a participant had not experienced one of the control video topics, the video was skipped. Video prompts are included in Appendix D. The final video stimuli were selected from participants who had recorded all three videos and who, during fNIRS calibration, showed at least 75% of channels with optimum calibration. Neural data from the storyteller needed to be very clean, as it would be compared to all other participants.

The selected storyteller had optimum calibration on all channels and was within one standard deviation of the mean age of all storyteller participants. This storyteller was also selected because she displayed considerable negative affect in the video about losing a loved one, as assessed by the research team and corroborated by the difference between her self-reported ratings on pre- and post-video short-form Positive and Negative Affect Scales (PANAS), which showed her to be 1.39 standard deviations above the mean. Thus this video had strong potential for inducing empathy in both shared and non-shared experience participants, as assessed by the research team. The storyteller's control video lengths were two minutes, thirty-

eight seconds, and two minutes, forty-four seconds. The storyteller's video discussing the loss of her loved one was initially five minutes, three seconds, but was trimmed to three minutes, nine seconds, due to a period at the beginning of the video when the storyteller did not speak.

Intervention training scripts. The mindfulness intervention training script was adapted from Westbrook et al. (2013), in which mindful attention training was successfully used to reduce nicotine cravings and subsequent cigarette use in smokers. The training instructed participants to be aware of their thoughts and feelings without judging them, accepting that they would eventually pass. The control condition was matched for tone but instructed participants to react as they naturally would. Training scripts are included in Appendix E.

Procedure

Participants were recruited using recruitment emails distributed by the UCLA Registrar's Office. These recruitment emails were sent pseudo-randomly to undergraduate women. Potential participants who replied to the email were screened for inclusion criteria, including gender, right-handedness, English language fluency, age of at least 18, and the loss of a close other within the last 3 years, depending on the recruitment email. General recruitment and recruitment of individuals who had lost a loved one occurred in alternating waves. Any participants recruited during a general recruitment wave who reported during the study survey that they had lost a close other were classified as shared experience participants in analyses.

Participants who met all inclusion criteria completed the study over approximately 1 hour in a laboratory setting. After providing consent, participants were measured and fitted with the correct size fNIRS cap, and completed calibration and baseline scans. Participants were randomly assigned to be led through either the control or intervention training. Trained experimenters led participants through a script (included in Appendix E), and assessed

participants' understanding of the training and success at implementing the training verbally throughout. During the training, participants viewed the two control videos, and were instructed to imagine that they were having a conversation with the storyteller in the videos. After completing the two control videos, participants were instructed to implement the training while watching the loss video. Participants then completed a short-form Positive and Negative Affect Scale (PANAS) and questions about the storyteller, including measures of how similar they felt they were to the storyteller, how much overall empathy and concern they felt toward the storyteller, and how successful they felt they were at implementing the training they received while watching the loss video.

Next, participants were asked to report whether they had experienced any of the events the storyteller talked about in her videos, and, if so, answered questions about when the event occurred and how much distress they currently felt about the event. Finally, all participants were debriefed about deception used during the directions for the video response task.

Measures

All measures are reported in full in Appendix E.

Key Variables.

Shared Experience. Shared experience was determined through participants' answer to the following question: "Have you had a death in your immediate family (e.g., parent, sibling or child), or of someone else very close to you (e.g., dating partner, close friend, etc.)?" Based on their answer participants were assigned to either the shared experience or non-shared experience conditions.

Similarity. Similarity was measured by two items that were averaged into a composite similarity measure. The items were, "How similar do you feel **you** are to your conversation partner?" and "How similar do you feel your **life experiences** are to your conversation partner?" These items were correlated at $r = .72$ (112), $p < .00001$. This variable served as a manipulation check that participants who were more similar to the individuals in the loss videos saw themselves as more similar.

Empathic Concern and Personal Distress. Participants in this study did not receive training on the definitions of empathic concern and personal distress. To measure empathic concern, participants were asked to report how much concern they felt for their 'conversation partner' (the storyteller), and to what extent they felt empathy toward their conversation partner. The two empathic concern items were correlated at $r = .5$ (112), $p < .00001$, and so were averaged to create a composite empathic concern measure.

Personal distress was measured using two items from the short-form PANAS, which participants completed directly after viewing the video about losing a loved one. These items, 'distressed' and 'upset,' were correlated at $r = .65$ (112), $p < .00001$, and were also averaged to create a composite personal distress measure.

The composite measures for empathic concern and personal distress were correlated at $r = .39$ (112), $p < .0001$. As in Study 1, each variable was regressed from the other to create residual variables representing variance unique to each construct. The residual variables were used for all analyses, and item correlations are reported in Table 1.

Success at Implementing Training. Participants' self-reported success at implementing the training they received while watching the video about losing a loved one was assessed with a single item, "How successful do you feel you were at implementing the training you were

given?" This item was used to assess whether to remove participants who were unable to implement their training during the main experimental task. Only 8 participants scored less than 4 on the 7-point scale, so no participants were removed.

Neural Data Preprocessing

Data collected with fNIRS was preprocessed using MATLAB R2019A and Homer2. Channels were inspected for motion artifacts and any such artifacts were corrected using Principle Component Analysis. Data were passed through a bandpass filter of 0.005 – 0.5 Hz to exclude machine signal drift. Using the Modified Beer Lambert Law, light intensity values were converted to percent change in oxygenated hemoglobin concentration relative to the scan's baseline average level. Data were then converted to Z-scores for analyses.

For spatial localization and visualization of the results, corresponding MNI coordinates of each 10-10 UI external channel position was determined using a probabilistic conversion atlas (Figure 2; http://www.jichi.ac.jp/brainlab/tools.html). Statistical results were calculated for each channel, and then linear interpolation was used to smooth the statistical maps between each channel's MNI location. Images were generated by converting NIRS results to .img/.hdr files using xjview (http://www.alivelearn.net/xjview/), which were then loaded into the Surf Ice brain surface rendering software.

Statistical Analysis

Neural synchrony. For analyses looking at synchrony between the storyteller and listeners, two-way analyses of variance were conducted using MATLAB R2019a, exploring the factors of intervention training condition and participant experience with loss. Groups compared were: participants with no experience of loss who completed the control training, participants

with experience of loss who completed the control training, participants with no experience of loss who completed the mindfulness training, and participants with experience of loss who completed the mindfulness training. T-tests were also conducted as follow-up analyses. fNIRS channel locations were translated to relevant brain regions using MNI coordinated to map onto the 10-10 system of electrode/optode placement. Neural data channels of interest were determined a priori based on relevant literature discussed previously. In particular, regions associated with empathic concern, personal distress, and mindfulness were examined. For empathic concern, vmPFC and precuneus regions were examined. For personal distress, SMA, premotor and somatosensory cortices were examined.

Preprocessed data were trimmed to match storyteller and empathizer start times and to remove the first 20 seconds of data after empathizers began watching the storyteller's video and the last 10 seconds of the video. Empathizers' preprocessed oxygenated hemoglobin levels per fNIRS channel were correlated to the storyteller's oxygenated hemoglobin levels per fNIRS channel, based on an optimum time lag between empathizer and storyteller to allow time for empathizers to process the storyteller's words. Lags of 2-10 measurements were assessed, and lag of 7 measurements, equaling 3.58 seconds, produced optimum synchrony. Storyteller/empathizer correlations were compared to a set of bootstrapped correlations generated by randomizing listeners' condition. F-statistics per channel were compared to bootstrapped null F-statistics to determine if a particular channel showed greater synchrony between storyteller and empathizer based on condition. For T-test analyses, t-scores per group per channel were compared to bootstrapped null t-scores.

Behavioral analyses. Behavioral analyses were conducted using IBM SPSS Statistics 20 and MATLAB R2019A. To look at the impact of intervention training condition and personal

experience with loss, univariate analyses of variance were conducted on both empathic concern and personal distress residuals. Post-hoc t-tests were also conducted.

Due to missing data or low-quality neural data, some participants were dropped from some analyses but included in others, so Ns varied across analyses.

Results

Similarity

Inter-item correlations are listed in Table 1. A univariate ANOVA analysis confirmed that participants with experience with loss (M = 4.67, SD = 1.49) viewed themselves as significantly more similar to the storyteller than participants with no such experience (M = 4.01, SD = 1.3), $F(1,106) = 5.28$, $p = .02$ (see Figure 1). Perceived similarity did not differ by condition (control M = 4.48, SD = 1.4; mindful attention M = 4.43, SD = 1.44), $F(1,106) = .13$, $p = .72$, and there was no significant interaction.

Interpersonal Neural Synchrony

Neural synchrony results are reported after correction for multiple comparisons using the false discovery rate (FDR) method. Looking at neural synchrony between the storyteller and listeners in regions associated with empathic concern and personal distress, we found greater synchrony between storyteller and participants with experience with loss (M = .03, SD = .15) than between storyteller and participants with no such experience (M = -.06, SD = 16) in a region spanning portions of left SMA, premotor cortex, and dlPFC (see Figure 2), t(103) = 2.88, p = .003.

Overall neural synchrony between storyteller and listener in one channel in this region, which corresponds with premotor cortex, was significantly correlated with the self-report measure of personal distress ($r = .3$ (99), $p = .002$). Multiple regression using first personal distress, then both personal distress and empathic concern residuals as predictors of synchrony in this channel was calculated, and both models were found to be significant; $F_1(1,97) = 8.4$, $p = .005$; $F_2(2,96) = 4.798$, $p = .01$. In the full model, empathic concern was not a significant predictor of this channel ($t(96) = 1.09$, $p = .28$). Examining the adjusted R^2, the model including empathic concern accounted for only 0.2% more of the variance in the model, and so was dropped from the model. Personal distress remained a significant predictor of neural synchrony in this channel ($\beta = .28$, $p = .005$).

Exploratory analyses revealed a small region in the superior parietal lobule (SPL) that showed overall negative synchrony and was significantly more negative for participants with no experience with loss ($M = -.1$, $SD = .14$) than participants who had lost a loved one ($M = -.02$, $SD = .16$) ,$t(103) = 2.11$, $p = .02$. As previously discussed, activation in this region is negatively correlated with viewing painful stimuli, and is also associated with working memory and mental imagery (Benuzzi et al., 2008, Knauff, Kassubek, Mulack, & Greenlee, 2000). Overall neural synchrony in this SPL region was significantly negatively correlated with the self-report measure of personal distress ($r = -.22$ (97), $p = .03$). Multiple regression analyses were again calculated using first personal distress, then both personal distress and empathic concern residuals as predictors of synchrony in this channel, and only the model with only personal distress was found to be significant; $F_1(1,95) = 4.93$, $p = .03$; $F_2(2,94) = 2.44$, $p = .09$. In the full model, empathic concern was not a significant predictor of this channel ($t(94) = .05$, $p = .96$). Examining the adjusted R^2, the model including empathic concern accounted for 1% *less* of the variance in

the model, and so was dropped from the model. Personal distress remained a significant inverse predictor of neural synchrony in this channel (β = -.22, p = .03).

Empathic Concern and Personal Distress

Univariate ANOVAs were conducted to determine the effect of intervention training condition and participant experience with loss on both empathic concern and personal distress (residual variables). These analyses are reported with all participants as well as selecting for participants who reported their success at implementing the training at 5 or higher, which dropped eight participants from analyses.

Looking at all participants, there was no effect of intervention condition on the empathic concern residual (control *M* = -.06, SE = .14; mindful attention *M* = .01, SE = .14), *F*(1,106) = .2, *p* = .66, nor was there a significant effect of participant experience with loss (shared experience *M* = .1, SE = .11; non-shared experience *M* = .03, SE = .19), *F*(1,106) = .92, *p* = .34. The interaction between condition and participant experience was also nonsignificant.

For the personal distress residual, there was a nonsignificant, yet trending, effect of intervention condition, with participants in the mindful attention condition (*M* = -.19, SE = .13) reporting slightly less personal distress than participants in the control condition (*M* = .19, SE = .12), *F*(1,106) = 2.96, *p* = .09. There was no significant effect of participant experience (shared experience *M* = .1, SE = .11; non-shared experience *M* = .03, SE = .15), *F*(1,106) = .92, *p* = .34 and no significant interaction.

Since the interaction was not significant, participant experience with loss was dropped from analyses and independent samples t-tests were conducted. As expected, for empathic concern, the t-test comparing control (*M* = .01, SE = .14) and mindful attention intervention (*M* = .17, SE = .14) was nonsignificant, t = .83, p = .41. Also as predicted, participants in the

mindful attention intervention (M = -.22, SE = .13) reported significantly less personal distress (residual) than participants in the control condition (M = .17, SE = .12), t(109) = -2.1, p = .04. Results are shown in Figure 1.

Discussion

Neural synchrony. The first main goal of this study was to determine whether individuals who have lost a loved one showed greater neural synchrony with a storyteller talking about their own experience with losing a loved one, particularly in neural regions related to personal distress. Personal distress represents self/other overlap, so greater synchrony in mirroring regions would indicate greater overlap between the storyteller and listener when addressing this painful topic. For individuals who have shared the experience, we hypothesized there would be greater self/other overlap and therefore greater synchrony. Greater synchrony for shared experience participants in one major region related to personal distress/mirroring was found, in a region encompassing portions of SMA, premotor cortex, and dlPFC. This region was found to be significantly correlated with a self-report measure of personal distress, and multiple regression showed that only personal distress, rather than empathic concern, predicted synchrony in this region.

These results match differences between self-reported empathic concern and personal distress in shared experience and non-shared experience, as shared experience participants reported significantly more personal distress than non-shared experience participants, while no significant differences between empathic concern were found. Taken together, the behavioral and neural data provide evidence that individuals who have shared a painful experience feel greater personal distress while maintaining similar levels of empathic concern as individuals with

no history with the painful experience, and that this greater personal distress represents greater synchrony with an empathy recipient in regions associated with greater self/other overlap.

Additionally, a region in the right superior parietal lobule (SPL) was found to be inversely related to self-reported personal distress, and shared experience participants showed *less* synchrony in this region than non-shared experience participants. This region was associated with less synchrony overall, across groups. As discussed, this region has been shown to decrease in activation in response to *observing* painful stimuli, but is unrelated to *experiencing* painful stimuli (Benuzzi et al., 2008). Since the storyteller was only experiencing the painful stimulus of reliving the experience of losing her loved one, but was not observing anyone in pain, it follows that there would be less synchrony between storyteller and listener in this region. And since shared experience participants reporting feeling greater personal distress while watching the storyteller's video, it also follows that they would have greater deactivation in right SPL, which would translate to less synchrony between storyteller and shared experience participants, compared to non-shared experience participants, who reported lower levels of personal distress.

Additionally, the SPL is associated with working memory and mental imagery (Knauff, Kassubek, Mulack, & Greenlee, 2000). Individuals who have shared an experience may need to do to less mental imagery work to imagine the storyteller's story and emotions compared to individuals who have no direct experience with loss.

Mindful attention intervention. The second major goal of this study was to test a potential intervention for reducing personal distress, and to see whether it was preferentially beneficial for shared experience participants. No significant effects were found based on an interaction between intervention condition and participant experience with loss, indicating that mindful intervention effects did not differ based on participant experience. Subsequent t-tests

looking at intervention condition only showed that participants in the mindful intervention reported no difference in felt empathic concern toward the storyteller, but participants in the mindful intervention condition reported feeling significantly less personal distress after viewing the video about loss than participants in the control condition.

These results provide preliminary evidence that mindful attention may be an effective means of reducing personal distress without also reducing empathic concern. As discussed, many emotion regulation strategies can reduce global affect. When considering empathy and related prosocial behavior, this can mean individuals down-regulating empathic concern as well as their personal distress, and since empathic concern has a stronger relationship with prosocial behavior, this global down-regulation may reduce resultant prosocial behavior. If a mindful attention intervention can reduce distress without negatively impacting empathic concern, then it may be more likely to lead to prosocial behavior than other emotion regulation strategies such as cognitive reappraisal or suppression. Future research should explore the role of mindful attention during empathy with a painful experience and its relationship with prosocial behavior, and could compare those results to other emotion regulation strategies' relationships with prosocial behavior.

Tables

Table 1.

Means, Standard Deviations, and Inter-Item Correlations Between Continuous Variables.

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	*M*	*SD*
1. Similarity	1									4.4	1.45
2. Felt Empathic Concern	.37**	1								0	1.05
3. Felt Personal Distress	.14	-.39**	1							0	0.93
4. Training Success	.14	.32**	-.13	1						5.55	1.35
5. Channel 3	.18	-.04	-.13	.05	1					0	1
6. Channel 33	.14	-.02	.28**	-.22*	.06	1				0	1
7. Channel 34	.15	-.18	.03	.00	.57**	.09	1			0	1
8. Channel 76	-.04	.1	-.222*	-.16	.13	.28**	.25*	1		0	1
9. FFMQ	-.01	.07	-.00	.4**	.02	-.22*	.12	-.04	1	3.14	.49

Notes. *$p \leq .05$, **$p \leq .01$, ***$p \leq .001$. EC and PD items are residuals. Channel items are Z scores of synchrony correlations between storyteller and empathizers.

Figures

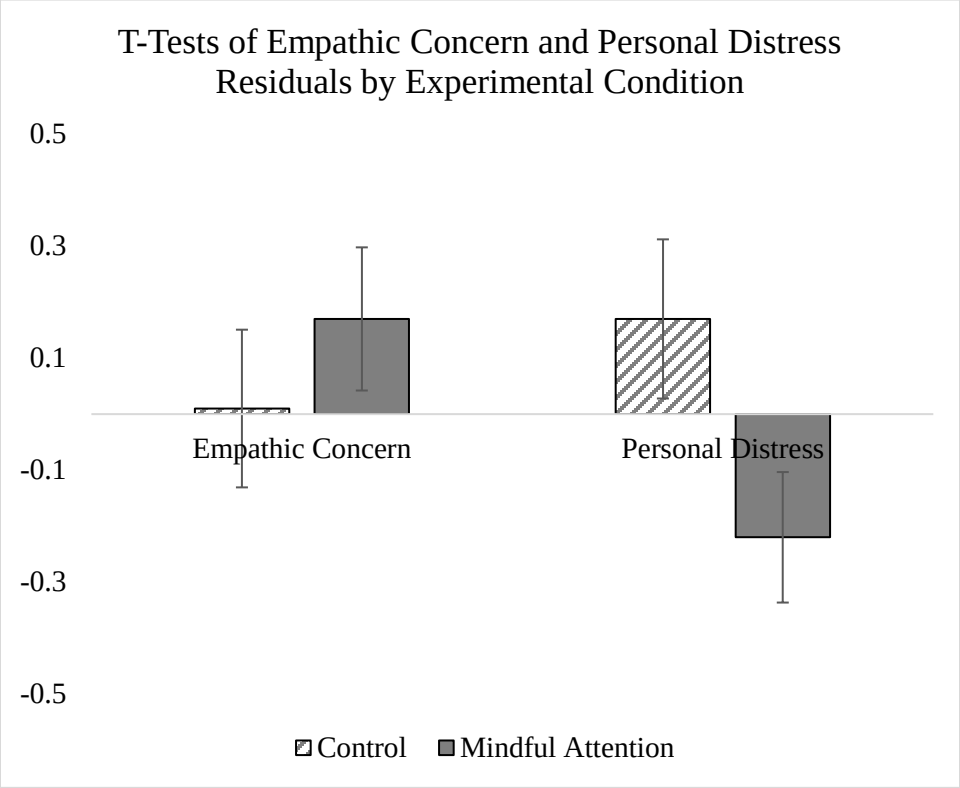

Figure 1. Comparison of residual empathic concern and personal distress by condition shows a significant difference for personal distress but not empathic concern.

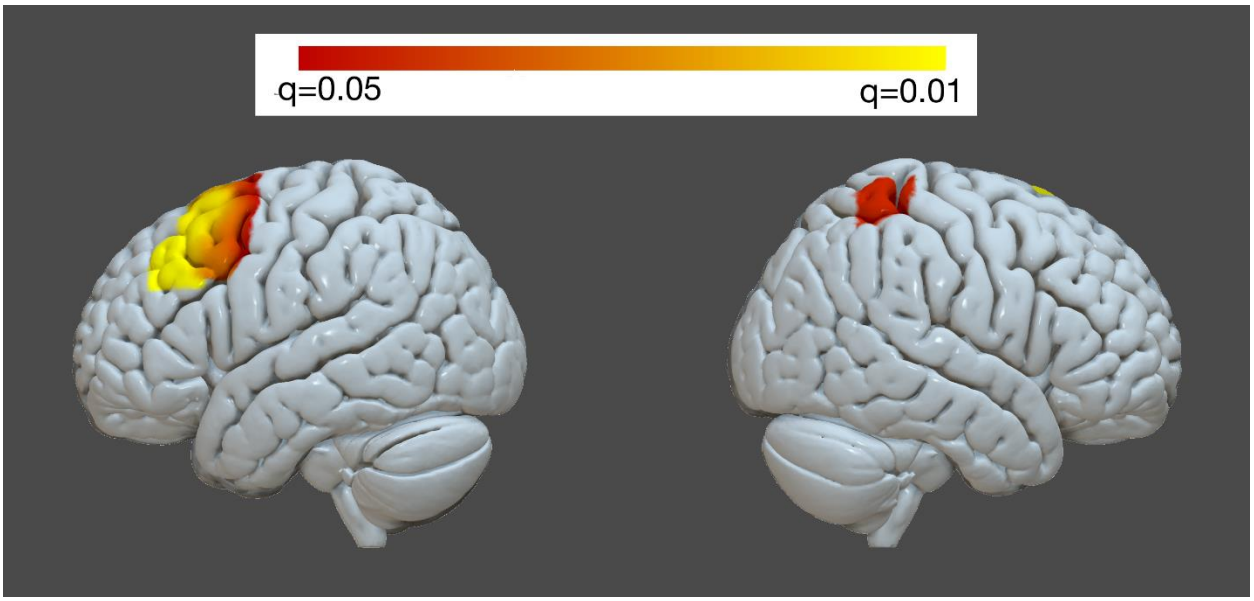

Figure 2. Neural synchrony between storyteller and listener during loss video. Significantly greater synchrony was displayed for participants with experience with loss in left SMA and premotor cortex, a region associated with personal distress, as well as a portion of dlPFC (left). Synchrony in the right superior parietal lobule (right) was negatively correlated with self-reported personal distress, and was participants with experience of loss had significantly less synchrony in this region than participants with no experience with loss.

Appendix C

Study 2 Storyteller Survey

Baseline PANAS

This scale consists of a number of words that describe different feelings and emotions. Read each item and then choose the appropriate item from the scale next to each word. **Indicate to what extent you feel this way right now, that is, at the present moment.**

	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
Distressed	○	○	○	○	○
Excited	○	○	○	○	○
Upset	○	○	○	○	○
Scared	○	○	○	○	○
Enthusiastic	○	○	○	○	○
Alert	○	○	○	○	○
Inspired	○	○	○	○	○
Nervous	○	○	○	○	○
Determined	○	○	○	○	○
Afraid	○	○	○	○	○

Prior Experience Questions:

On the next page we will be asking about some negative events you may have experienced. Some events may or may not apply depending on your life. The following questions will help us narrow down which events apply to you.

Have you ever received a poor grade in a class or on a specific exam/assignment?

- ○ Yes
- ○ No

You indicated you have received a poor grade on an assignment, exam, or in a class as a whole. If you have received multiple poor grades, please think about the assignment/exam/course that was most upsetting to you. Keep this assignment/exam/course in mind when answering the following questions.

To what extent do you currently feel distress about the poor grade you received?

- Not at all
-
-
- Moderately
-
-
- Very Much

About how long ago did you receive the poor grade? If less than 1 year, enter a 0 for "Years." If 1 year or greater, round to closest year and enter 0 for "Months."

- Years _____
- Months _____

How old were you when you received the poor grade? Round to the nearest whole year.

_____

Have you ever experienced a breakup, in which you or a significant other ended your relationship?

- Yes
- No

You indicated you have experienced a breakup. If you have experienced multiple breakups, please think about the most painful breakup you have experienced. Keep this breakup in mind when answering the following questions.

To what extent do you currently feel distress about this breakup?

- Not at all
-
-
- Moderately
-
-
- Very Much

About how long ago did the breakup occur? If less than 1 year, enter a 0 for "Years." If 1 year or greater, round to closest year and enter 0 for "Months."

- Years _____
- Months _____

How old were you when the breakup occurred? Round to the nearest whole year.

_____

Have you ever had someone very close to you die? This could include immediate family

members/caregivers, a partner, a close friend, a roommate, etc.

- Yes
- No

You indicated you have lost someone close to you. If you have lost multiple people close to you, please think about the person to who you were closest. Keep this experience in mind when answering the following questions.

To what extent do you currently feel distress about this experience of losing a close other?

- Not at all
-
-
- Moderately
-
-
- Very Much

About how long ago did the experience occur? If less than 1 year, enter a 0 for "Years." If 1 year or greater, round to closest year and enter 0 for "Months."

- Years _____
- Months _____

How old were you when you lost this person? Round to the nearest whole year.

_____

Post-Video PANAS:
This scale consists of a number of words that describe different feelings and emotions. Read each item and then choose the appropriate item from the scale next to each word. **Indicate to what extent you felt these emotions during the event you just described - that is, at the time that it happened.**

	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
Distressed	○	○	○	○	○
Excited	○	○	○	○	○
Upset	○	○	○	○	○
Scared	○	○	○	○	○
Enthusiastic	○	○	○	○	○
Alert	○	○	○	○	○
Inspired	○	○	○	○	○
Nervous	○	○	○	○	○
Determined	○	○	○	○	○
Afraid	○	○	○	○	○

Indicate to what extent you feel this way right now - that is, at the present moment.

	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
Distressed	○	○	○	○	○
Excited	○	○	○	○	○
Upset	○	○	○	○	○
Scared	○	○	○	○	○
Enthusiastic	○	○	○	○	○
Alert	○	○	○	○	○
Inspired	○	○	○	○	○
Nervous	○	○	○	○	○
Determined	○	○	○	○	○
Afraid	○	○	○	○	○

Appendix D

Study 2 Storyteller Video Prompts

Received a poor grade:

Take a moment to think about the worst grade you have ever received (in a class or on an individual assignment/exam).

Please record a short video, about 3 - 6 minutes, about how you felt when the event occurred, how you dealt with the experience (whether effectively, ineffectively, or both), and how you feel now about the grade. Remember that the purpose of this video is to describe your emotional experience, rather than just reporting the facts.

Before recording your video, please take as much time as you need to compose your thoughts, but don't worry about it being perfect; we are looking for your natural expression and thoughts. As such, you will be given the opportunity to record only one video.

When you are ready to record your video, please inform the experimenter.

Breakup:

Take a moment to think about the most painful breakup you have experienced.

Please record a short video, about 3 -6 minutes, about how this breakup has affected your life. This could include how you felt when the event occurred, how you dealt with the experience (whether effectively, ineffectively, or both), and how you feel now about the relationship ending.

Since this video will be viewed by another participant, please do not include demographic information, such as the relation between you and person you were dating (e.g., refer to them as, "my partner" or "my ex"). Also please do not use concrete numbers regarding your or your ex's age at the time of the breakup. Remember that the purpose of this video is to describe your emotional experience, rather than the facts.

When you are ready to record your video, please inform the experimenter.

Loss

Take a moment to think about the person closest to you who you have lost, and the experience of losing them.

Please record a short video, about 3 - 6 minutes, about how the experience of losing someone close to you has affected your life. This could include how you felt when the death occurred, how you dealt with the loss (whether effectively, ineffectively, or both), and how you feel now about your loss.

Since this video will be viewed by another participant, please do not include demographic information, such as the relation between you and the person you lost (e.g., refer to them as, "the person I lost" or "my relative" rather than "mother," "brother," etc.). Also please do not use concrete numbers regarding age at the time of the death, or how specifically they died. Remember that the purpose of this video is to describe your emotional experience, rather than the facts.

Important: before you begin, please take a minute to just think about your loved one. Think about what they meant to you, what you loved about them, and how their loss made you feel.

When you are ready to record your video, please inform the experimenter.

Act of Kindness:

Take a moment to think about a time when someone was kind to you. It could be a close friend, family member, or significant other, or maybe a stranger. Please think of one event that lasted long enough for you to tell a short story about the event.

Please record a short video story, about 3 – 6 minutes, about this event. This story could include what the act of kindness was, how it made you feel in the moment, and how you feel about the person who acted kindly toward you.

Since this video will be viewed by other participants, please do not include identifying information about other people. Keep the story focused on your experience.

When you are ready to record your video, please inform the experimenter.

Appendix E

Study 2 Mindset Training Scripts

SCRIPT A (Control):

1. "In this study we are interested in how different mindsets may influence the way you think and feel about what you experience when you're hearing others' emotional stories. A mindset is a way of thinking about your thoughts and feelings. For the main task of the study, we will be asking you to respond to another participant's emotional story. To prepare for this task, we want to familiarize you with the process so when you actually watch the video you will know what to do and won't be distracted.

   When you are watching the videos, imagine that you are in a conversation with the person in the video, who is sitting in front of you telling their story. Imagine that this conversation will involve you replying to what they say. While they are talking, we want you to take in what they're saying and feeling, without doing anything different than what you would normally do when hearing someone talk about something painful. We just want you to react naturally.
2. Do you have any questions about what you're supposed to do?" *wait for questions*
3. "Just to make sure we're on the same page, can you tell me in your own words what it is we would like you to do while watching the video?" *wait for response*
4. *If correct, say*: "Great! Yes, like you said, we want you to imagine you're in a conversation with this person and we want you to listen and respond internally the way you normally would when someone is telling you about something they've gone through."
5. *If incorrect, (depending on the way it is incorrect) say something like*, "That's sort of what we want, but to be more specific, we want you to imagine you're in a conversation with this person and we want you to listen and respond internally the way you normally would when someone is telling you about something they've gone through. Does that make sense?"
6. Repeat process and clarification until they're totally clear on what they are supposed to do.
7. "Great! Now let's practice with a video. I'm going to play a video for you of a practice conversation video about receiving a bad grade. Like we said, just react naturally. Ready?" Pull up Video 1 from Emotion Responses 2 Listener Stimulus Videos.
8. "I'll leave the room while the video is playing. Once the video finishes, you can complete the next survey questions until you reach a stop sign. Ring the bell when you're done. Now I'd like you to hit play on the video when I say GO**."** *Hit record on fNIRS, then say* "**GO**" *right as you hit "done" on the popup screen. Leave the room.*
9. "Okay, how well do you think you did at following our directions for what you are supposed to do during the video?" *Wait for answer. If they need further clarification, read them the directions again and help them understand their task.*
10. "Great! Let's practice one more time with a video about a breakup." *Repeat step 8 w/ Video 2*
11. "It sounds like you're ready for the main task."

SCRIPT B (Mindfulness Intervention):

1. "For the main task of the study, we will be asking you to respond to another participant's emotional story. To prepare for this task, we want to familiarize you with the process so when you actually watch the video you will know what to do and won't be distracted."

2. "In this study we are interested in what happens when people adopt different types of mindsets in response to others' emotional stories. A mindset is a way of thinking about your thoughts and feelings. We are particularly interested in how adopting different mindsets may influence the way you think and feel about the nature of the event you are experiencing. Here is an example:

   Suppose there is a bus and you're the driver. On this bus there are a number of passengers. The passengers are your thoughts. Furthermore, assume for the moment that all the passengers riding on your bus are intimidating, and each is yelling directions about where you have to go. "You've got to turn left," "You've got to go right," and so on. The threat they have over you is that if you don't do what they say, they're going to come up front from the back of the bus and start trouble. So you feel as though you must obey these passengers and follow their directions to avoid trouble.

   But notice there are things you can do. In this study we're interested in learning about what these "things", (we'll call them mindsets) are and how you can use them to influence your experience. One thing you can do is notice that even though your passengers may be intimidating while they're on the bus, their presence is only temporary. That is, passengers regularly come and go. Passengers get off the bus at each stop and new ones get on. So when you find yourself in a state of distress because your passengers are shouting, remind yourself that their presence is only temporary."

3. For the task, we would like you to put yourself into this type of mindset in which you notice but accept without judging or reacting to any emotion, thought, or sensation you experience and recognize that their presence is only temporary and will soon pass (like passengers on a bus, they will be replaced at a later point with different thoughts as you continue to experience new things)." *Ask if they have questions so far*

4. When you are watching the videos, imagine that you are in a conversation with the person in the video, who is sitting in front of you telling their story. Imagine that this conversation will involve you replying to what they say. While they are talking, you should try to maintain a state of acceptance so that whatever responses you might have – whether negative or otherwise – are allowed to pass by without troubling or upsetting you. Simply attend to what you feel, without making any judgment of the "goodness" or "badness" of that feeling – remember that it is temporary. Each sensation or fleeting feeling will pass by without troubling you. Do you have any questions about what you're supposed to do?" *wait for questions*

5. "Just to make sure we're on the same page, can you tell me in your own words what it is we would like you to do while watching the video?" *wait for response*

6. *If correct, say*: “Great! Yes, like you said, we want you to imagine you’re in a conversation with this person and we want you to pay attention to what you’re feeling without making any judgement about those feelings or trying to change them.”
7. *If incorrect, (depending on the way it is incorrect) say something like*, “That’s sort of what we want, but to be more specific, we want you to imagine you’re in a conversation with this person and we want you to pay attention to what you’re feeling without making any judgement about those feelings or trying to change them. Does that make sense?”
8. Repeat process and clarification until they’re totally clear on what they are supposed to do.
9. “Great! Now let’s practice with a video. I’m going to play a video for you of a practice conversation video about receiving a bad grade. Like we said, just pay attention to what you’re feeling without judgement and don’t try to change it. Ready?” Pull up Video 1 from Emotion Responses 2 Listener Stimulus Videos.
10. “I’ll leave the room while the video is playing. Once the video finishes, you can complete the next survey questions until you reach a stop sign. Ring the bell when you’re done. Now I’d like you to hit play on the video when I say GO**.”** *Hit record on fNIRS, then say* “**GO**” *right as you hit “done” on the popup screen. Leave the room.*
11. “Okay, how well do you think you did at following our directions for what you are supposed to do during the video?” *Wait for answer. If they need further clarification, read them the directions again and help them understand their task.*
12. “Great! Let’s practice one more time with a video about a breakup.” *Repeat step 10 with Video 2*
13. “It sounds like you’re ready for the main task.”

Appendix F

Study 2 Empathizer Survey

PANAS: given at baseline and after each video

This scale consists of a number of words that describe different feelings and emotions. Read each item and then choose the appropriate item from the scale next to each word. **Indicate to what extent you feel this way right now, that is, at the present moment.**

	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
Distressed	○	○	○	○	○
Excited	○	○	○	○	○
Upset	○	○	○	○	○
Scared	○	○	○	○	○
Enthusiastic	○	○	○	○	○
Alert	○	○	○	○	○
Inspired	○	○	○	○	○
Nervous	○	○	○	○	○
Determined	○	○	○	○	○
Afraid	○	○	○	○	○

'Conversation Partner' Questions:

The next questions are about your conversation partner, the person whose video you just watched.

How similar do you feel **you** are to your conversation partner?

- ○ Not at all (1)
- ○ (2)
- ○ (3)
- ○ Moderately (4)
- ○ (5)
- ○ (6)
- ○ Very much (7)

How similar do you feel your **life experiences** are to your conversation partner?

- ○ Not at all (1)
- ○ (2)
- ○ (3)
- ○ Moderately (4)
- ○ (5)
- ○ (6)
- ○ Very much (7)

How **close** do you feel to your conversation partner?

- ○ Not at all (1)
- ○ (2)
- ○ (3)
- ○ Moderately (4)
- ○ (5)
- ○ (6)
- ○ Very much (7)

How much **concern** do you feel for your conversation partner?

- ○ Not at all (1)
- ○ (2)
- ○ (3)
- ○ Moderately (4)
- ○ (5)
- ○ (6)
- ○ Very much (7)

How much do you **like** your conversation partner?

- ○ Not at all (1)
- ○ (2)
- ○ (3)
- ○ Moderately (4)
- ○ (5)
- ○ (6)
- ○ Very much (7)

To what extent did you feel **empathy** toward your conversation partner?

- ○ Not at all (1)
- ○ (2)
- ○ (3)
- ○ Moderately (4)
- ○ (5)
- ○ (6)
- ○ Very much (7)

To what extent do you feel you **understood** how your conversation partner felt?

- ○ Not at all (1)
- ○ (2)
- ○ (3)
- ○ Moderately (4)
- ○ (5)
- ○ (6)
- ○ Very much (7)

How **warmly** do you currently feel toward your conversation partner?

- ○ Not at all (1)
- ○ (2)
- ○ (3)
- ○ Moderately (4)
- ○ (5)
- ○ (6)
- ○ Very much (7)

How successful do you feel you were at implementing the training you were given before participating?

- ○ Not at all (1)
- ○ (2)
- ○ (3)
- ○ Moderately (4)
- ○ (5)
- ○ (6)
- ○ Very much (7)

Do you know your conversation partner from outside the study?

- ○ Yes (1)
- ○ No (2)

Life Experiences Questionnaire:

On the next page we will be asking about some negative events you may have experienced. The following questions will help us narrow down which events apply to you.

Have you ever received a poor grade in a class or on a specific exam/assignment?

- Yes (1)
- No (2)

You indicated you have received a poor grade on an assignment, exam, or in a class as a whole. If you have received multiple poor grades, please think about the assignment/exam/course that was most upsetting to you. Keep this assignment/exam/course in mind when answering the following questions.

To what extent do you currently feel distress about the poor grade you received?

- Not at all (1)
- (2)
- (3)
- Moderately (4)
- (5)
- (6)
- Very Much (7)

About how long ago did you receive the poor grade? If less than 1 year, enter a 0 for "Years." If 1 year or greater, round to closest year and enter 0 for "Months."

- Years (1) _____
- Months (2) _____

How old were you when you received the poor grade? Round to the nearest whole year.

_____

Have you ever experienced a breakup, in which you or a significant other ended your relationship?

- Yes (1)
- No (2)

You indicated you have experienced a breakup. If you have experienced multiple breakups, please think about the most painful breakup you have experienced. Keep this breakup in mind when answering the following questions.

To what extent do you currently feel distress about this breakup?

- Not at all (1)
- (2)
- (3)
- Moderately (4)
- (5)
- (6)
- Very Much (7)

About how long ago did the breakup occur? If less than 1 year, enter a 0 for "Years." If 1 year or greater, round to closest year and enter 0 for "Months."

- Years (1) _____
- Months (2) _____

How old were you when the breakup occurred? Round to the nearest whole year.

_____

Have you ever had someone very close to you die? This could include immediate family members/caregivers, a partner, a close friend, a roommate, etc.

- Yes (1)
- No (2)

You indicated you have lost someone close to you. If you have lost multiple people close to you, please think about the person to who you were closest. Keep this experience in mind when answering the following questions.

To what extent do you currently feel distress about this experience of losing a close other?

- Not at all (1)
- (2)
- (3)
- Moderately (4)
- (5)
- (6)
- Very Much (7)

About how long ago did the experience occur? If less than 1 year, enter a 0 for "Years." If 1 year or greater, round to closest year and enter 0 for "Months."

- Years (1) _____
- Months (2) _____

How old were you when you lost this person? Round to the nearest whole year.

_____

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General Discussion

Shared history with negative emotional experiences has been largely ignored in empathy neuroscience literature, yet these studies demonstrate that shared experience changes empathy, both neurally and experientially, for empathizers, and can also impact targets of empathy in terms of support received. Study 1 demonstrated that individuals who had prior experience with loss of a loved one reported feeling more personal distress than individuals who had no prior experience with loss, when observing an empathy target talk about their own experience with loss. Empathic concern remained consistent regardless of shared experience, meaning that individuals who had been through a similar experience as the empathy target felt additively more empathy-related emotions, but that addition was in the form of greater personal distress at the target's distress.

These results were replicated in Study 2, which showed the same pattern of similar empathic concern but greater personal distress for shared experience participants compared to non-shared experience participants. Study 2 also corroborated these findings in the neural analyses, which showed greater synchrony between empathizer and empathy target in regions related to personal distress for participants who shared the experience of loss. This increase in personal distress for shared experience individuals did not translate to a reduction in prosocial behavior, as sometimes occurs with higher levels of personal distress (Batson, et al., 1987; Eisenberg & Fabes, 1990). Social support, in the form of notes to empathy targets, shared experience individuals offered was rated by independent raters as higher quality than support offered by non-shared experience participants. Finally, Study 2 tested a potential intervention, mindful attention, and found it to be effective at reducing personal distress without also reducing empathic concern.

Future Directions and Implications

There are considerable implications for the findings related to shared experience and prosocial behavior. In terms of offered support, individuals who had experienced loss were just as likely to offer support as individuals who had no experience with loss. Greater personal distress, shown in this dissertation to relate to shared experience, predicted greater offered support for one of the loss-experience empathy targets. This particular target spoke about how the loss of her loved one caused her to drop out of school and withdraw from friends and family. While not interrogated in this research, future research could explore the role of perceived empathizer *target* distress and need in motivating shared experience participants to offer support. Previous research has established that perceiving greater distress can motivate greater helping behaviors, but prolonged, high levels of distress can reduce social support (Dunkel-Schetter & Skokan, 1990). Given that shared experience individuals studied in this dissertation reacted differently to the empathy target compared to non-shared experience individuals, and that the relationship between prosocial behavior and personal distress may be different from the same relationship for non-shared experience individuals, further research is needed to explore how an empathy target's distress impacts like likelihood that individuals who have shared the experience will offer social support.

For both empathy targets who had lost loved ones, individuals who shared that experience wrote more supportive notes of encouragement than individuals who had never lost someone close to them. This finding is of particular importance given evidence that individuals experiencing a distressing event prefer to receive support from others who have been through similar experiences (Barnes & Lieberman, manuscript; Hodges et al., 2010), as well as findings that providing support offers positive benefits to the person providing the support (Doré et al.,

2017; Rini et al., 2014; Staub & Vollhardt, 2008). Individuals who have experienced a distressing event may feel more personal distress when empathizing with someone currently experiencing a similar distressing event, but may be able to alleviate that extra distress through offering support. This could have long-term benefits to well-being, as well. Research on post-traumatic growth finds that individuals who find meaning and connection with others through their traumatic experience show consistently higher measures of mental health and well-being, and these effects seem to last long-term (Hassija & Turchik, 2016; Tedeschi & Calhoun, 1996). Future research should explore any mental health and well-being impacts of offering support to, or receiving support from, someone who has been through a similar negative experience has yourself.

In addition to contributing to our understanding of the role shared experience plays in empathy and prosocial behavior, this dissertation also clarified the relative impacts of empathic concern and personal distress, and identified key neural regions related to personal distress that can be used in future fNIRS empathy studies. In study 1, intensity of activation in several channels of neural data was found to predict intensity of personal distress, and these channels were in a region that showed increased neural synchrony for shared experience individuals, who also felt more personal distress. The region located has been shown to relate to personal distress using other neuroimaging methods, namely fMRI (Ashar et al., 2017; Gallese et al., 2004). Taken together, the neural results for Studies 1 and 2 provide compelling evidence for the role of this region in the experience of personal distress when empathizing with an emotional pain, particularly when the empathizer has experienced a similar emotional pain.

These findings are beneficial for future empathy researchers hoping to use a neuroimaging method that allows for more ecologically valid study designs. In particular, these

findings could be used to conduct simultaneous scans of empathizers and empathy targets, commonly referred to as hyperscanning (Liu et al., 2017). In fNIRS hyperscanning, researchers may limit the regions they examine, as they are using one machine to record neural activity from multiple participants simultaneously. Additionally fNIRS has less precise spatial resolution than fMRI and can only detect activation a few centimeters into the cerebral cortex, so it is more difficult to find specific regions related to constructs of interest. Having preestablished regions of interest (ROIs) for specific constructs allows for more targeted neuroimaging and greater power to detect significant differences. fNIRS is still relatively uncommon in social neuroscience research, so there is benefit in establishing ROIs that correspond with both behavioral indices of a social psychological construct as well as known ROIs from fMRI research.

Finally, the mindful attention intervention tested in Study 2 has implications for support-providers and suggests future directions. The mindful attention intervention training took only about 15 minutes to complete with the aid of a trained experimenter, and was effective at reducing personal distress while leaving empathic concern intact. Since the intervention requires relatively little time and training, its effectiveness could be tested outside the lab. For instance, the intervention could be tested with individuals who offer support on a regular basis, whether sustained support to a specific distressed individual (e.g., in-home caregivers) or to numerous distressed individuals (e.g., triage nurses). In Study 2, the intervention only needed to be effective for one video. Important moderators of its effectiveness could be determined by testing the intervention in these more intensive environments. Future research should also test whether the intervention training could be adapted for autonomous use, so that individuals could train themselves. This would increase its usefulness and generalizability. Additionally, for this research individuals were explicitly told to utilize the mindful attention intervention; future

research could examine whether individuals who have received the training spontaneously utilize it in encounters with distressed individuals, and whether spontaneous use differs from directed use in terms of effectiveness.

Final Conclusions

Through two studies we explored how shared experience impacts personal distress and empathic concern, and investigated neural regions associated with personal distress as well as how shared experience relates to neural synchrony. We also addressed the impact of personal distress on prosocial behavior in individuals who have shared a painful emotional experience and tested an intervention aimed at reducing personal distress. Together, the two papers (1) located neural regions related to personal distress; (2) determined that shared experience with loss increased personal distress and interpersonal neural synchrony in regions associated with personal distress, and also increased the quality of offered prosocial support; and (3) provided preliminary evidence for the effectiveness of mindful attention as an intervention for reducing personal distress.

Shared experience is an often-overlooked aspect of the empathizer/target relationship, and this dissertation aimed to demonstrate that prior experience with a type of distressing event can have a significant impact on how the empathizer feels as well as the quality of support the empathizer offers. Empathy researchers should consider participant history when designing studies, and should explore shared experience as an important moderator in relationships between empathic concern, personal distress, and prosocial behavior. This is particularly important given the potential for mutual benefit between empathizer and target when individuals who have shared the target's distressing experience offer them social support. Additionally, reducing personal distress benefits empathizers by making the empathizing experience less

aversive, but the mindful attention intervention adapted and tested in this dissertation has potential to benefit empathy targets, as well, since it does not simultaneously reduce empathic concern, a key motivator for prosocial behavior. In sum, the research in this dissertation contributed to the neuroscientific understanding of empathic concern and personal distress, and laid foundations for ways to improve the empathizer/target relationship so that both individuals may leave the better for having shared in each other's emotional experiences.

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