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Publication Date

2020

Peer reviewed|Thesis/dissertation

An Examination of Cognitive and Emotional Empathy in
Caregivers of Persons with Neurodegenerative Disease: Relationships with Mental Health

by

Alice Yu Hua

A dissertation submitted in partial satisfaction of the

requirements for the degree of

Doctor of Philosophy

in

Psychology

in the

Graduate Division

of the

University of California, Berkeley

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Spring 2020

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Abstract

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Caregivers of Persons with Neurodegenerative Disease: Relationships with Mental Health

by

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Doctor of Philosophy in Psychology

University of California, Berkeley

Professor Robert W. Levenson, Chair

Caring for a loved one with a neurodegenerative disease can be highly rewarding, but it can also have devastating effects on caregivers' mental health. Research on vulnerability and resilience to the negative effects of caregiving has emerged over the past few decades, largely focusing on disease factors and caregiver demographics, resources, personality, and coping strategies. The extent to which caregivers' own emotional functioning, specifically their empathy, relates to their mental health is poorly understood. Because caregiving encompasses a multitude of interpersonal experiences with the person in their care, and emotions play an important role in these interactions, caregiver empathy may be particularly important for their mental health. Thus far, no known studies have utilized laboratory measures of caregiver empathy in examination with caregiver mental health. The present study addressed these gaps by using laboratory measures of two kinds of empathy: cognitive empathy (*understanding* others' emotions) and emotional empathy (*sharing* others' emotions). In 78 caregivers, we examined cognitive empathy (i.e., accuracy in emotion recognition from films and continuous ratings of a person's emotions) and emotional empathy (i.e., physiological, behavioral, and self-reported emotional experience to a film depicting suffering) in relation to caregiver mental health (validated questionnaires of depression and anxiety). Results revealed that greater emotional empathy in caregivers (i.e., greater report of negative and caring emotions in response to the film depicting suffering) was associated with worse caregiver mental health. This relationship remained stable when accounting for caregiver physiological and behavioral responses to the film, measures of caregiver cognitive empathy, measures of caregiver emotional reactivity, or a measure of cognitive empathy in the person with neurodegenerative disease. Measures of caregiver cognitive empathy were not related to caregiver mental health. The relationship between caregiver emotional empathy and caregiver mental health was not moderated by disease or caregiver factors known to make caregivers more vulnerable to negative mental health outcomes (i.e., frontotemporal dementia diagnosis, caregiver female gender). These findings identify emotional empathy as a potentially important vulnerability in caregivers of persons with neurodegenerative diseases. One implication of these findings is that, when facing a chronic stressor such as a caregiving, caregivers who are higher in emotional empathy may benefit from strategies that create emotional distance in response to their loved ones' suffering.

An Examination of Cognitive and Emotional Empathy in Caregivers of Persons with Neurodegenerative Disease: Relationships with Mental Health

Over 35 million adults worldwide have been diagnosed with dementia and other neurodegenerative diseases; these debilitating diseases negatively impact cognitive, emotional, and motor functioning (Prince et al., 2013). The prevalence of these diseases is projected to more than triple by the year 2050 (World Health Organization, 2012). As the number of older adults continues to grow (World Health Organization, 2017), caregiving will likely become an increasingly common concern for many families.

Although caring for a family member with a neurodegenerative disease can be a highly rewarding experience, including enhanced spirituality and sense of fulfillment or purpose (Abdollahpour, Nedjat, & Salimi, 2018), this role can also have devastating effects on caregivers' health. Many caregivers, but not all, experience negative mental health symptoms, including up to a four-fold increase in rates of depression and three-fold increase in seeking treatment for anxiety compared to same aged non-caregiving adults (Brodaty & Donkin, 2009; Coope et al., 1995; Cuijpers, 2005; Kolanowski, Fick, Waller, & Shea, 2004). Caregivers who experience these poor mental health outcomes may be compromised in their ability to provide high quality care (Beach & Schulz, 2017), creating a vicious cycle of decline in both caregivers and the persons with dementia or neurodegenerative disease (PWD). For example, PWDs who were cared for by someone with poor mental health died 14 months sooner compared to those who were cared for by someone with good mental health (Lwi, Ford, Casey, Miller, & Levenson, 2017). While these negative effects of caregiving are sobering, it is important to recognize that caregivers differ in how profoundly, if at all, they experience poor mental health outcomes. Thus, it is important to understand the factors that account for these individual differences.

PWD factors that influence caregiver mental health

The majority of studies on vulnerability and resilience to the negative effects of caregiving have examined characteristics of the PWD. An emerging consensus from the literature suggests that greater severity of PWDs' behavioral and psychological symptoms (e.g., delusions, agitation, apathy) is worse for caregiver burden and health outcomes, even more so than cognitive or functional symptoms (Matsumoto et al., 2007; Merrilees et al., 2013; Ornstein & Gaugler, 2012; Richard Schulz, O'Brien, Bookwala, & Fleissner, 1995). Neurodegenerative diseases target different large-scale brain networks (Seeley, Crawford, Zhou, Miller, & Greicius, 2009), so affected persons present with different symptom profiles. People with frontotemporal dementia are broadly characterized by changes in social and emotional functioning (apathy, reduced empathy; Kumfor & Piguet, 2012; Rascovsky et al., 2011; Rosen et al., 2002), whereas people with Alzheimer's disease are characterized by cognitive symptoms (e.g., problems with memory; McKhann et al., 2011). Given the importance of behavioral symptoms, research suggests that caring for someone with frontotemporal dementia may be worse for one's mental health than caring for someone with Alzheimer's disease (Ascher et al., 2010; De Vugt et al., 2006; Riedijk et al., 2006).

Furthermore, research has shown that declines in several aspects of PWDs' emotional functioning, including empathy (the ability to know, feel, and respond appropriately to what others are feeling; Levenson & Ruef, 1992), emotional reactivity (the type, magnitude, and duration of an emotional response; Levenson et al., 2008), and emotion regulation (the processes individuals use to influence when, how, and how much they have an emotional experience;

Gross, 2015), are negatively associated with caregivers' psychological well-being. In the empathy realm, PWDs' reduced empathy in the form of recognizing others' emotions on an empathic accuracy laboratory task (i.e., correctly tracking the emotional valence of a person in a film) or from caregiver report of PWDs' emotion recognition ability is associated with greater caregiver depression and burden (Brown et al., 2017; Hsieh et al., 2013). In the emotional reactivity realm, greater endorsement of extraneous negative emotions (i.e., negative emotions the stimuli were not intended to induce) by the PWD in response to positive and negative emotional stimuli is associated with lower emotional well-being in the caregiver (Chen et al., 2017); and fewer expressions of genuine smiles by PWDs in a social interaction with the caregiver is associated with lower caregiver mental health (Lwi et al., 2018). In the emotion regulation realm, lower reduction of visual attention to disgusting stimuli by PWDs is associated with greater caregiver psychological distress (Otero & Levenson, 2017). Consistent with these findings, neuroimaging data suggests that greater damage to the right ventral anterior insula and the superior medial frontal gyrus, two regions important for emotional reactivity and regulation, in PWDs is associated with poor caregiver mental and physical health (Hua et al., 2019).

Together, these findings highlight that reduced PWD emotional functioning, a diagnosis of frontotemporal dementia, and PWD neurodegeneration in brain regions that are critical for emotional functioning are important factors in influencing caregiver vulnerability to negative mental health outcomes.

Caregiver factors that influence caregiver mental health

Research on caregiver factors that influence vulnerability and resilience to caregiving have largely not focused on emotional functioning in caregivers. Instead, research on caregiver factors has more thoroughly examined demographic variables, financial resources and support, personality, and coping strategies. Independent demographic factors, such as being the spouse of a PWD, female, or young, are associated with greater strain and psychological morbidity in caregivers (Brodaty & Donkin, 2009; Richard Schulz et al., 1995). Lower income and greater social isolation (i.e., less social contact and social support) while caring for the PWD are considered important barriers to a more positive caregiving experience (Brodaty & Donkin, 2009; Richard Schulz et al., 1995). In terms of caregiver personality, high levels of neuroticism and low self-esteem are associated with worse caregiver psychological well-being (Alvira et al., 2015; Brodaty & Donkin, 2009). A review on caregiver approaches when caring for the PWD suggests that greater use of emotion-based coping strategies (e.g., escape avoidance through efforts to avoid dealing with a stressor), instead of problem-focused coping strategies (e.g., confrontive coping by taking action, facing responsibilities, and dealing with difficulties effectively), is associated with greater levels of caregiver anxiety and burden (Cooper, Balamurali, & Livingston, 2006). Research on caregiver personality and coping strategies clearly suggests that *how* caregivers face their caregiving experiences is an important factor in influencing the trajectory of their mental health. Considering that caregiving encompasses a multitude of interpersonal experiences with the PWD, and that emotions play an important role in these interactions, there is an important research gap in examining caregivers' *own* emotional capabilities in relation to their mental health.

Caregiver emotional functioning and caregiver mental health

Few studies have examined caregivers' emotional functioning (i.e., caregiver emotional reactivity, regulation, or empathy) as assessed using well-controlled laboratory-based procedures

(Levenson et al., 2008) or how this relates to their own mental health. In terms of emotional reactivity, a meta-analysis of six studies reported that family members of PWDs with high expressed emotion – high levels of criticism, hostility, emotional over-involvement when discussing the PWD-caregiver relationship – had greater levels of burden and depression compared to family members with low expressed emotion (Safavi, Berry, & Wearden, 2015). These findings, in conjunction with studies on caregiver personality, suggest that a propensity to experience negative emotions may be important in shaping how caregivers perceive their role and respond to problematic behaviors in PWDs. Indeed, interventions designed to increase caregivers' positive emotions (e.g., expressing gratitude, practicing positive reappraisal) have shown improved psychological outcomes, including reduced depression, distress, and burden (Dowling et al., 2013).

In terms of emotion regulation (i.e., appraising a situation), a study categorized spousal caregivers' attitudes from interviews as positive, ambivalent, or negative and suggested that caregivers who describe a positive caregiving experience focus on the PWDs' needs and may fare better than caregivers who endorse ambivalent or negative attitudes toward caregiving (Shim, Barroso, & Davis, 2012). Consistent with the protective effects of problem-based coping strategies, caregivers who focus on the PWDs' needs may be more adept at identifying how the PWD feels in order to provide better care.

In terms of empathy, a cross-sectional, self-report-based study on caregivers of older adults (the majority of care recipients had dementia) reported that caregivers with greater cognitive empathy (i.e., understanding another's emotions) appraised the caregiving situation as less stressful and less threatening; they also reported greater life satisfaction than caregivers with low cognitive empathy (Lee, Brennan, & Daly, 2001). In contrast, greater emotional empathy (i.e., sharing another's emotions) in caregivers was negatively associated with their life satisfaction (Lee et al., 2001). Although these studies suggest that caregivers' own emotional characteristics are strongly related to how they respond to the challenges of caregiving, these studies did not comprehensively measure caregivers' emotional functioning by capturing caregivers' real-life emotional capabilities (i.e., ability to recognize others' emotions from a validated task). Comprehensive measures of emotional functioning can be realized through carefully designed laboratory tasks. (Additional advantages of laboratory tasks are discussed below).

Recent work from our laboratory has measured caregiver emotional functioning in relation to caregiver mental health. In the realm of emotional reactivity, caregivers' genetic propensity for greater emotional reactivity (albeit a biological proxy for emotional reactivity, not a direct measure of emotional reactivity) moderates the relationship between reduced PWD emotional functioning and lower caregiver well-being (Wells et al., 2019). More specifically, caregivers with the short/short genotype of the 5-HTTLPR polymorphism in the serotonin transporter gene, which has been shown to increase vulnerability to environmental stressors (Canli & Lesch, 2007), experienced lower well-being (i.e., depression, anxiety, negative affect) when the PWD had lower empathy (i.e., recognizing others' emotions on a laboratory-based empathic accuracy task) compared to caregivers with the short/long or long/long genotype. In the realm of emotion regulation, caregivers who are less effective at suppressing their emotions (i.e., show more expressive facial behavior) when instructed to hide their emotions in response to a disgust eliciting film reported greater levels of anxiety (Wells, Hua, & Levenson, in prep). Together, these studies provide evidence that greater caregiver emotional reactivity when caring for a PWD with low empathy and poor caregiver emotion regulation ability are worse for

caregiver mental health. Caregiver empathy, however, has not yet been measured using well-controlled laboratory procedures and investigated in relation to caregiver mental health.

Cognitive and emotional empathy

Given the highly interpersonal nature of caregiving, caregiver empathy likely influences how a caregiver responds to their PWD's symptoms. Empathy is often referred to as the ability to know, feel, and respond appropriately to what others are feeling (Levenson & Ruef, 1992) and can be further broken down into cognitive and emotional facets. Cognitive empathy is defined as the ability to *know or understand* another person's emotions, whereas emotional empathy is defined as the ability to *feel or share* others' emotional states (Decety & Jackson, 2006; Preston & de Waal, 2002; Singer & Lamm, 2009; Zaki, Weber, Bolger, & Ochsner, 2009). Furthermore, each aspect of empathy may have different consequences for caregiver mental health as caregivers respond to their PWDs' needs differently (Lee et al., 2001). For example, PWDs may exhibit symptoms of distress. A caregiver with high cognitive empathy may accurately *understand* that the PWD has a higher need for care, which can lead to more effective ways of dealing with the PWD. In contrast, a caregiver with high emotional empathy may *share* the PWD's distress, which can lead to the caregiver being overwhelmed by their own sense of distress.

Empathy and health outcomes

Generally, empathy – including both cognitive and emotional facets – is associated with numerous positive benefits when “receiving” empathy from others or “sending” empathy to others in most individuals. As the “receiver” of empathy, individuals experience greater relationship satisfaction in close relationships when they perceive their partners to be good at recognizing their emotions, or high in cognitive empathy (Davis & Oathout, 1987), and greater satisfaction and health outcomes at the doctor's office when individuals perceive their care providers to be good at perspective-taking and demonstrating a caring attitude, or high in both cognitive and emotional empathy (greater health outcomes include better control of hemoglobin A1c in diabetes, robust immune responses measured by inflammatory cytokine levels in nasal secretions; Blatt, Lelacheur, Galinsky, Simmens, & Greenberg, 2010; Hojat et al., 2011; Raket et al., 2009). In psychotherapy, meta-analyses have consistently shown that clients who perceive their therapist to be more empathic have better therapeutic alliance and better clinical outcomes (Elliott, Bohart, Watson, & Murphy, 2018). As the “sender” of empathy, individuals who are good recognizers of emotion (high in cognitive empathy) experience greater satisfaction in close relationships (Morelli, Lieberman, & Zaki, 2015). Moreover, individuals who are perceived by others to be high in empathy (cognitive and emotional facets) are sought out for trust and support and have greater well-being compared to less empathic individuals (Morelli, Ong, Makati, Jackson, & Zaki, 2017; Wei et al., 2011).

For professional care providers (e.g., clinicians, nurses, physicians), outcomes related to having greater empathy as the “sender” are more mixed. On the one hand, care providers who demonstrate more cognitive and emotional empathy have fewer malpractice complaints, greater well-being, and more emotional stability (Huntington & Kuhn, 2003; Krasner et al., 2009). On the other hand, being overly empathic by overly identifying with care recipients' emotional experiences can be costly for the care provider. Compassion satisfaction (e.g., positive feelings derived from helping others through traumatic situations) is associated with greater demonstration of empathic concern and perspective taking, which reflects emotional and

cognitive empathy, whereas compassion fatigue (e.g., burnout and secondary traumatic stress) is more closely associated with personal distress, which reflects greater emotional empathy (Gleichgerricht & Decety, 2013). Because care providers are exposed to high levels of negative emotions in stressful environments, they can develop empathy burnout and emotional exhaustion (Figley, 2011), which can impede their ability to provide quality care and increase the risk of errors (Decety & Fotopoulou, 2014). Although the opportunity to be empathic with PWDs is at the root of why many providers are drawn to challenging interpersonal work, this experience can lead to empathic distress, emotional exhaustion, and burnout when one does not have the ability to adequately help or respond (Ekman & Halpern, 2015). Research proposes that the key to balanced empathy as the “sender”, sometimes called “professional empathy”, is maintaining a clear awareness of the distinction between the suffering of the person receiving care and one’s own experience (Ekman & Halpern, 2015; Halpern, 2001).

To summarize, greater cognitive empathy is usually beneficial for a physician when caring for a PWD, whereas greater emotional empathy can interfere with a physician’s ability to make effective decisions regarding diagnosis and outcomes (Decety, Smith, Norman, & Halpern, 2014). Furthermore, the way that cognitive empathy and emotional empathy interact may have different consequences. For example, when physicians have high cognitive empathy and low emotional empathy, they can rely on cognitive resources without feeling burned out to provide assistance and express concern (Decety et al., 2014). Conversely, physicians may be less effective when cognitive empathy is low (i.e., depleted cognitive resources) and emotional empathy is high (i.e., greater risk for burnout). In general, however, professional healthcare providers’ health likely depends on the successful deployment of cognitive and emotional empathy together.

Altogether, the literature on professional care providers suggests that forms of cognitive empathy (e.g., understanding others’ needs) that allow the provider to have an appropriate amount of emotional distance lead to better career outcomes and psychological well-being for the provider, whereas forms of emotional empathy (e.g., sharing others’ distress) tend to lead to emotional exhaustion and lower psychological well-being for the provider. While professional care providers are formal caregivers through career choice, caregivers of PWDs are informal caregivers, who are providing extended, unpaid care for their family members (World Health Organization, 2012). These informal caregivers are in a uniquely personal and prolonged stressful context. Being highly immersed in a loved one’s behavioral, cognitive, or physical decline as full-time caregivers can make it difficult to have emotional distance from the PWDs’ needs. Thus, some caregivers may find themselves responding more with emotional empathy, regardless of their cognitive empathy ability. Moreover, caregivers may be simultaneously be mourning the loss of their loved ones, compounding the effect of this burnout, as PWDs with neurodegenerative diseases exhibit progressive, unrelenting decline in their functioning. Overall, caregivers who have greater emotional empathy may experience greater emotional exhaustion and burnout that leads to poor psychological health and well-being.

Self-report of cognitive empathy and emotional empathy

One feasible and popular way to measure cognitive and emotional empathy is through self-report instruments, in which participants rate their own empathy or close others (i.e., study informants) rate participants’ empathy. Self-report instruments have been helpful in understanding empathy in numerous populations and topics, including age-related differences in empathy (Beadle, Sheehan, Dahlben, & Gutchess, 2013) and reduced empathy in clinical

populations (Rankin, Kramer, & Miller, 2005). However, these self-report instruments have limitations, including being subject to reporter bias by the participant or the study informant (Furnham & Henderson, 1982) and not consistently measuring cognitive and emotional empathy separately (Neumann, Chan, Boyle, Wang, & Rae Westbury, 2015). Laboratory tasks that measure cognitive empathy typically use an external criterion to determine accuracy (e.g., consensual agreement of outside observers) (Ickes, 1997). Such tasks can provide more comprehensive information about an individual's performance or empathic. Unfortunately, self-report instruments are not always equivalent to laboratory-based measures of empathy (Ickes, 1997; Kurtz & Grummon, 1972; Levenson & Ruef, 1992). More careful examination of emotional functioning may benefit from measurement of multimodal responses (i.e., physiological, behavioral, self-reported emotional experience) to experimental laboratory tasks and utilizing more ecologically relevant stimuli (Levenson et al., 2008; Riaz, Wolden, Gelblum, & Eric, 2016; Zaki & Ochsner, 2012).

Laboratory tasks of cognitive empathy

Recent approaches to measuring cognitive empathy typically take the form of emotion recognition (e.g., correctly identifying the emotions portrayed in static facial expressions; Neumann, Chan, Boyle, Wang, & Rae Westbury, 2015). Although widely used, static emotion recognition tasks are limited in ecological validity. Emotion recognition requires integration of several streams of information, including visual, auditory, social context, and face and body movement. Improved ecological validity can be found in tasks that require recognizing the emotions of target characters in films. Using this type of film-based task, researchers have identified emotion recognition impairments in individuals with neurodegenerative diseases (Goodkind et al., 2015) and traumatic brain injury (Neumann & Zupan, 2018). To capture the dynamic nature of emotion recognition, researchers have developed a task that requires participants to use a rating dial to track the moment-to-moment changes in the valence (negative, neutral, positive) of the emotions of a target character in a film (Levenson & Ruef, 1992; Ruef & Levenson, 2007). Using dynamic tracking tasks, researchers have identified neural correlates for cognitive empathy in healthy individuals (Zaki et al., 2009) and for impairments in performance on this task in PWDs with neurodegenerative diseases (Goodkind et al., 2012).

The present study utilized two measures of cognitive empathy derived from affective science: (1) a film-based emotion recognition task where caregivers identify the emotion of a character in several films, and (2) a dynamic tracking task where caregivers track the changing valence of a person's emotions in an interaction. Both tasks maximize ecological validity by presenting stimuli with multiple streams of information (e.g., visual, auditory, social context, face and body movement). Both tasks utilize an external criterion to assess accuracy; accuracy for the film-based task was computed by comparing ratings with those from undergraduate research participants, and accuracy for the dynamic tracking task was computed by comparing ratings with an expert panel of ratings (see Methods for more details). Utilizing two measures of cognitive empathy allowed us to capture different aspects of recognizing others' emotions in real-world interpersonal situations: one that is based on identification of a particular emotion and another that is based on continuous monitoring of the valence of others' emotions as they unfold over time.

Laboratory tasks of emotional empathy

Laboratory tasks that measure emotional empathy typically capture participants' responses when viewing human suffering, such as a person in emotional pain or distress (Hein & Singer, 2008; Lamm, Decety, & Singer, 2011; Marsh, 2018). While most studies use this kind of stimuli, the measurement of participants' responses to these stimuli varies. Some researchers have focused on participants' physiological responses, such as functional connectivity through neuroimaging or peripheral physiology through skin conductance (Decety et al., 2014; Singer et al., 2004). Other researchers ask participants to rate their emotional experience (e.g., how much concern they felt for a target) to the stimuli (Hysek et al., 2014; Marsh, 2018; Zaki, Davis, & Ochsner, 2012). Moreover, other researchers have focused on measuring behavioral responses, such as facial mimicry using electromyography (Likowski et al., 2012; Sun, Wang, Wang, & Luo, 2015) or prosocial actions (Bartlett & Desteno, 2006; Beadle et al., 2013; Sturm et al., 2018; Sturm et al., 2017).

Although many studies of emotional empathy have incorporated two types of responses (e.g., functional connectivity and emotion ratings), few studies measure physiological, behavioral, and self-reported emotional experience (for a study that measured all three, see: Sze, Gyurak, Goodkind, & Levenson, 2012) and even fewer measure all three types of responses to the same stimulus. Measuring all three types of responses to the same stimulus could help determine the specific types of emotional empathy responses that are related to caregiver mental health.

The present study measured all three types of caregivers' responses (physiological reactivity, facial behavior, and self-reported emotional experience) to a film depicting human suffering to measure emotional empathy.

Considering caregiver emotional reactivity

Given the multi-faceted nature of empathy, there could be a number of independent but related factors that influence our empathic responses to others. A person's level of emotional reactivity (Levenson et al., 2008) could be one such factor. For example, a person with greater emotional reactivity may be able to engage more empathically because their heightened responding helps them understand or feel how another person feels. Rueckert and colleagues found that those with greater self-reported emotional responses had greater self-reported empathic responses than those with lower self-reported emotional responses (Rueckert, Branch, & Doan, 2011). Similarly, one's empathic ability to know or feel someone else's emotions could influence one's emotional response. Davis and colleagues found that participants' with greater trait empathy had greater negative emotional reactivity when watching film clips selected to induce negative emotions (Davis, Hull, Young, & Warren, 1987). Although determining whether emotional reactivity influences empathy or vice versa was not a focus of this study, it is important to measure both to account for potential influences of one on the other. Specifically, it is important to account for caregivers' emotional reactivity to a negative or aversive stimulus, because previous studies suggest that a tendency toward greater negative emotionality in caregivers relates to worse caregiver mental health (Brodaty & Donkin, 2009; Safavi et al., 2015; Shim et al., 2012).

The present study measured caregiver emotional reactivity in terms of their physiological, behavioral, and self-reported emotional experience to an aversive acoustic startle stimulus under two conditions: unanticipated and anticipated. In the unanticipated condition, caregivers were not aware that the acoustic startle stimulus would be presented. After the unanticipated condition,

caregivers underwent the anticipated condition when caregivers were aware when the acoustic startle stimulus would be presented. This anticipated condition assessed emotional reactivity when participants anticipated a negative or aversive context, which more closely reflects caregivers reacting to anticipated problematic behaviors in PWDs.

Considering PWD empathy

Because the relationship between caregiver empathy using laboratory-based measures and caregiver mental health has not yet been examined, the primary focus of this study was to examine how caregiver empathy relates caregiver mental health. However, empathy on the part of both the caregiver and the PWD is critically important to interpersonal functioning. Caregivers who are recipients of poor PWD empathy (i.e., lower empathic accuracy in recognizing others' emotions) have been shown to be vulnerable to poor mental health (Brown et al., 2017; Hsieh et al., 2013; Wells et al., 2019). Accounting for the influence of poor PWD empathy on caregivers can help clarify the influence of caregiver and PWD emotional factors on caregiver mental health.

The present study utilized a measure of PWDs' empathy in which PWDs track the changing valence of a character's emotions in a film; PWD impairments on this task has been shown to be associated with lower caregiver mental health (Brown et al., 2017).

The Present Study

Research on vulnerability and resilience to the negative effects of caregiving has emerged over the past few decades, largely focusing on PWD factors and caregiver demographics, resources, personality, and coping strategies. The extent to which caregivers' own emotional functioning, specifically their empathy, relates to their mental health is poorly understood. The present study sought to address this gap by utilizing ecologically valid, laboratory-based measures of cognitive empathy and emotional empathy that reflect the caregiver's ability to *know* other's emotions and to *feel* other's emotions, respectively. The present study also measured two factors that may relate to the relationship between caregiver empathy and caregiver mental health: caregiver emotional reactivity and PWD empathy. The major research questions addressed were: (a) the relationship between caregiver empathy and caregiver mental health, and (b) whether the relationship between caregiver empathy and caregiver mental health is moderated by PWD diagnosis or caregiver gender.

Method

The present study utilized an archival dataset collected from 2012-2018 as part of an ongoing study of emotional functioning in PWDs and in their familial or close primary caregivers.

Participants

Seventy-eight PWDs and their familial or close caregivers participated in a study of emotional functioning at the Berkeley Psychophysiology Lab at the University of California, Berkeley (UCB) between 2012-2018. Participants were recruited at the Memory and Aging

Center at the University of California, San Francisco (UCSF), where PWDs underwent a full diagnostic evaluation, including neurological, neuropsychological, and neuroimaging assessment. Caregivers of PWDs being evaluated at UCSF were contacted if they expressed interest in participating in a study of emotional functioning at UCB. All participants, or the legal guardians as appropriate, consented to participate in a day-long assessment in our laboratory at UCB that consisted of a number of tasks (Levenson et al., 2008). Both PWDs and caregivers participated in as many tasks as possible (numbers for each task are noted below).

Sample demographics

Caregivers were mostly spouses of PWDs seen at UCSF (92.3%), with the exception of six caregivers who were either a close friend, partner (not married), son, or other relative of the PWD. Caregivers' age ranged from 30 to 78 with a mean age of 64.52 years. Caregivers were majority female (60.3%) and White or European American (83.3%). PWDs' age ranged from 32 to 78 with a mean age of 62.15 years. Less than half of the PWDs were female (43.6%) and the majority of PWDs were White or European American (80.8%). For more details on caregiver and PWD demographics, see Table 1.

At UCSF, PWDs were diagnosed according to consensus criteria (Armstrong et al., 2013; Budka et al., 1995; Gorno-Tempini et al., 2011; Klockgether, 2010; Litvan et al., 1996; McKeith, 2004; McKhann et al., 2011; Rascovsky et al., 2011). The PWD sample encompassed a heterogeneous set of diagnoses. Thirty-three had frontotemporal dementia (FTD), which includes three clinical syndromes that affect socioemotional and language functioning (16 behavioral variant FTD, 9 non-fluent variant primary progressive aphasia, 8 semantic variant primary progressive aphasia). Eleven had Alzheimer's disease (AD), which predominantly affects memory functioning. 25 had diagnoses that were characterized by motor symptoms (Motor), including 9 with corticobasal syndrome, 2 with dementia with Lewy body disease, 1 with Parkinson's disease, 1 with prion disease, 11 with progressive supranuclear palsy, and 1 with spinocerebellar ataxia. Nine were at risk for developing a neurodegenerative disease, which included 5 individuals diagnosed with mild cognitive impairment (MCI) and 4 individuals who were relatives of a person with FTD.

Procedure

Upon arrival at the Berkeley Psychophysiology Laboratory, all participants (PWDs and caregivers) reviewed the procedures for the day and completed consent forms with the assistance of a graduate student experimenter. PWDs and caregivers were then seated in separate rooms and non-invasive physiological sensors (see more details below) were attached to participants to monitor their physiological responses. Participants sat in a chair facing a 21-inch color monitor and were video recorded for each task using a remote-controlled camera that was partially hidden from view. With several breaks given, participants participated in a 7-hour laboratory session designed to provide a comprehensive assessment of emotional functioning that measured empathy, emotional reactivity, and emotion regulation (Levenson et al., 2008). Following the completion of the laboratory session, PWDs and caregivers completed video consent forms, which indicated how their video recordings could be used (ranging from no use, to research use, to use in future talks and publications to a research audience, to showing the general public). Each PWD and caregiver dyad was paid \$120 at the end of the study for their participation. All procedures were approved by the Committee for the Protection of Human Subjects at the University of California, Berkeley.

The present study focused on data from the empathy and emotional reactivity tasks. For caregivers, data were included from cognitive empathy (emotion recognition task, dynamic tracking task), emotional empathy (film depicting suffering task), and emotional reactivity tasks (acoustic startle tasks). For the PWDs, data were included from a cognitive empathy task (dynamic tracking task) that has been previously studied in association with caregiver mental health (Brown et al., 2017).

Apparatus and coding

Rating dial. For one of the cognitive empathy tasks (the dynamic tracking task), a rating dial was placed near the dominant hand of the participant following previously established procedures (Ruef & Levenson, 2007). The rating dial consisted of a small metal box with a rotating knob and attached pointer that rotated across a 180° semi-circle. The semi-circle was divided into 9 equal divisions labelled with descriptors of “very bad” (shown with a schematic frowning face) at the far left, “neutral” (shown with a schematic neutral face) in the middle, and “very good” (shown with a schematic smiling face) at the far right. The dial generated a voltage that reflect the dial position (1 to 9) and a computer measured the average dial position at every second.

Physiology. Physiological responses were calculated by creating a composite of physiological measures to capture overall arousal to the film. Physiological measures were monitored continuously using a Biopac polygraph, a computer with analog-to-digital capability, and an online data acquisition and analysis software package written by Robert W. Levenson. The program computed second-by-second averages for the following measures: (a) heart rate—inter-beat interval was the time interval in milliseconds between successive R waves, using Beckman miniature electrodes with Redux paste that were placed on opposite sides of the participants’ chest; (b) finger pulse amplitude—a UFI photoplethysmograph recorded the amplitude of blood volume in the finger using a photocell taped to the distal phalanx of the index finger of the nondominant hand; (c) finger pulse transmission time—the time interval in milliseconds was calculated between the R wave of the electrocardiogram and the upstroke of the peripheral pulse at the finger site, recorded from the distal phalanx of the index finger of the nondominant hand; (d) ear pulse transmission time—a UFI photoplethysmograph recorded the volume of blood in the ear to measure transmission time between the R waves of the electrocardiogram signal and the upstroke of pulse at the ear; (e) systolic blood pressure and (f) diastolic blood pressure—a cuff placed on the ring finger of the participant’s nondominant hand calculated blood pressure on every heartbeat using an Ohmeda Finapress 2300; (g) skin conductance level—the electrical conductance of the skin was computed using a constant voltage device to pass voltage between Beckman regular electrodes on the ring and index fingers of the nondominant hand to calculate the sweat response; (h) somatic activity—the amount of overall movement was computed using an electromechanical transducer attached to the platform of the participant’s chair; (i) respiration rate—the inter-cycle interval was the time interval in milliseconds between breaths calculated using a pneumatic bellows stretched around the thoracic region.

We selected nine measures (heart rate, finger pulse amplitude, finger pulse transmission time, ear pulse transmission time, systolic and diastolic blood pressure, skin conductance, somatic activity, and respiration rate) to sample from major autonomic (cardiovascular, electrodermal, respiratory) and somatic systems associated with emotional responding. For each measure, the average of the resting baseline period (detailed below) was subtracted from the

average obtained during the task period (detailed below) to create a difference score for physiological reactivity. Averages for each physiological reactivity score were normalized, reverse scored if necessary (so that larger values reflected greater physiological arousal), and then averaged. These physiological measures and the composite measure that combines all nine channels to reduce Type I error have been described in detail in several other publications (Sturm, Rosen, Allison, Miller, & Levenson, 2006; Verstaen et al., 2016).

Facial Behavior Coding. Facial behavior was recorded continuously using a remote-controlled, high-resolution video camera. Trained coders rated participants' facial behavior using the Emotional Expressive Behavior coding system (Gross & Levenson, 1993). Facial behavior was coded second by second for nine emotional facial behaviors (anger, disgust, happiness/amusement, contempt, sadness, embarrassment, fear, surprise, and confusion) on an intensity scale ranging from 0 to 3.

Caregiver cognitive empathy: Emotion recognition and dynamic tracking tasks

Emotion Recognition Task. Participants watched a series of 11 film clips selected to assess recognition of negative, positive, and self-conscious emotions; these films were selected based on emotion structure (the character experienced one emotion of interest), thematic simplicity (easily understandable contexts), and pilot data (ratings from undergraduates confirmed the recognition of the target emotion; Goodkind et al., 2015). The film clips showed a character experiencing a positive (affection, amusement, calmness, enthusiasm), negative (anger, disgust, fear, sadness), or self-conscious emotion (embarrassment, pride, shame). Each film clip lasted 37 seconds in length and was preceded by a 30 second baseline period during which an "X" was on the monitor. After watching each film clip, participants were shown a picture of the target character displaying a neutral expression. Participants were asked to identify the specific emotion the target character felt most strongly from a list of the 11 emotions. Data on this task was obtained from 78 participants.

Dynamic Tracking Task. Participants watched videos of two different heterosexual married couples having conversations. These conversations were selected from a previous dataset that followed couples longitudinally (Haase, Holley, Bloch, Verstaen, & Levenson, 2016; Verstaen, Haase, Lwi, & Levenson, 2018) and were previously used in a study of empathy in older adults (Sze, Goodkind, Gyurak, & Levenson, 2012). For each video, participants were asked to focus on rating the emotions of a target person (i.e., the husband) who was highlighted with a green dot above the head. Using the rating dial, participants rated the emotions of the target person by moving the rating dial continuously to indicate how positive or negative they believed the target person felt at each moment. Each video lasted 243 seconds. Data on this task was obtained from 78 participants.

Data reduction. For the emotion recognition task, accuracy on this task was calculated by summing correct answers across film clips, with a minimum score of 0 and a maximum score of 11. For the dynamic tracking task, accuracy on this task was calculated using time-lagged cross correlations to calculate the agreement between a caregiver's moment-to-moment ratings of the target person's emotions and the averaged ratings from an expert panel of healthy individuals. To allow for differences in processing speed, the maximum correlation coefficient was selected for lags between -10 or +10 seconds following methods previously used with this task (Brown et al., 2017). Because performances for both videos on the dynamic tracking task were significantly correlated ($r = .59, t = 6.37, p < .001, 95\% \text{ CI } [.42, .72]$), a composite accuracy score was calculated by averaging the maximum cross correlation coefficient for the two videos. Higher

averaged cross correlation coefficients indicated greater accuracy on the cognitive empathy task. Because performances on the emotion recognition and the dynamic tracking tasks were not significantly correlated (see **Table 2**), accuracy measures from cognitive empathy task were used in analyses as separate variables. **Figure 1** displays the distributions of these measures.

Caregiver emotional empathy task: Film depicting suffering

Task. Participants watched a film clip selected to induce concern and distress for others' suffering. The film clip shows images of suffering in Darfur. This film clip lasted 120 seconds and was preceded by a 60 second baseline period during which an "X" was on the monitor. After the film, participants rated on a 0-2 scale how much they felt specific positive and negative emotions (affection, fear, amusement, anger, shame, disgust, embarrassment, enthusiasm, pride, surprise) as well as concern and distress. This film has been effective at inducing concern and distress in young, middle-aged, and older adults (Sze, Gyurak, et al., 2012). The nine physiological measures described earlier were monitored throughout this task. Facial behavior was recorded and subsequently coded. Data on this task was obtained from 78 participants.

Data reduction. Physiological responses to the film were computed by subtracting the average level of each measure during the pre-film baseline from the average level during the last 80 seconds of the film, which was selected as the most emotionally intense period of the film based on a healthy control sample who showed the most intensity in their facial behavior during this window (Sze, Gyurak, et al., 2012). Facial behavior for this task was coded during the last 80 seconds of the film. Given the negative nature of the Darfur film, facial behavior was the sum of intensity for negative emotions (sadness, confusion, anger, fear, surprise, contempt, disgust). Inter-coder reliability was strong (intraclass correlation coefficient = .83). Self-reported emotional experience for this task were computed by summing the total reported intensity for negative (fear, anger, surprise, sadness, disgust, shame, distress) and caring emotions (affection, concern). Because physiological, facial behavior, and self-reported emotional experience to this film were not significantly correlated, these caregiver emotional empathy responses were included in analyses as separate variables (See **Table 2**). **Figure 1** displays the distributions of these measures.

Caregiver emotional reactivity: Acoustic startle tasks

Unanticipated Startle Task. Participants were told to relax and watch the computer screen. An "X" appeared on the screen when the pre-trial baseline began and remained in view for 60 seconds. After the 60 seconds, a loud startle stimulus (115 dB, 100 ms burst of white noise) was presented without warning using hidden speakers behind the participant. Participants then sat through a 60 second post baseline period during which an "X" was presented on the screen. After the post baseline period, participants rated on a 0-2 scale how much they felt specific positive and negative emotions (affection, fear, amusement, anger, shame, disgust, embarrassment, enthusiasm, pride, surprise). This acoustic startle task has been shown to be an effective measure of emotional reactivity in response to an aversive stimulus in healthy older adults (Levenson et al., 2008; Sturm et al., 2006). The nine physiological measures described earlier were monitored throughout this task. Facial behavior was recorded and subsequently coded. Data on this task was obtained from 58 participants.

Anticipated Startle Task. Participants were informed that the startle stimulus would be presented at the end of a countdown. Following a 60 second baseline in which an "X" was presented on the screen during which the participants were instructed to relax, a countdown from

10 to 0 was presented through the screen and a speaker. The acoustic startle stimulus was then presented, followed by a 60 second post baseline period during which an “X” was presented on the screen. Peripheral physiology was measured throughout this task. Facial behavior was recorded and subsequently coded. Data on this task was obtained from 58 participants.

Data reduction. Physiological, behavioral, and self-reported emotional experience to the unanticipated and anticipated startle tasks were computed separately. Physiological responses to both startle tasks were computed by subtracting the average level of each measure during the pre-task 60 second baseline from the average level during the startle and 15 seconds after the startle stimulus. This period of time during the onset of the acoustic stimulus and 15 seconds post-startle is adequate to capture the entire startle response (Sturm et al., 2006). Facial behavior for both startle tasks were coded when the startle was presented through 15 seconds after the startle stimulus. Similar to previous studies (Sturm et al., 2006), a measure of overall emotional facial behavior was obtained by summing the intensity for surprise, sadness, anger, fear, disgust, embarrassment, and amusement. These emotional behaviors are consistent with previous work indicating that participants typically demonstrate a primary negative response to the startle stimulus, followed by a secondary response that is a “response to having been startled”. This secondary response varies across individuals and can look like amusement and/or embarrassment (Levenson et al., 2008; Sturm et al., 2006). Inter-coder reliability was high for both startle tasks (intraclass correlation coefficient = .85). Self-reported emotional experience for both startle tasks was computed by summing the total intensity for emotions that were similar to negative and secondary responses for facial behavior (surprise, sadness, anger, fear, disgust, embarrassment, and amusement). Caregiver anticipated startle responses were included in analyses as measures of emotional reactivity (i.e., their level of responsivity to a negative stimulus when warned, similar to caregiving experiences when anticipating problematic behaviors in PWDs) while accounting for caregiver unanticipated startle responses (i.e., their level of responsivity to the startle without warning). See **Figure 1** for distributions of anticipated startle measures.

PWD cognitive empathy: Dynamic tracking

Task. Participants watched a film clip selected to measure continuous recognition of the valence and intensity of a person’s emotions. Participants watched a Disneyland commercial that lasted 80 seconds. In the film clip, a woman is having a conversation over dinner with a man. The woman’s emotions fluctuate between negative and positive extremes throughout the clip. Similar to the methods described above, participants used a rating dial to provide continuous ratings of a target person’s (i.e., the woman’s) emotions to indicate how positive or negative they believed she felt at each moment. Data on this task was obtained from 64 participants.

Data reduction. Accuracy on this task was calculated using time-lagged cross correlations to calculate the agreement between a PWD’s moment-to-moment ratings of the target person’s emotions and the average of ratings obtained from an expert panel of healthy individuals. To allow for differences in processing speed, particularly for PWDs with cognitive or motor impairments, the maximum correlation coefficient was selected for lags between -10 and +10 seconds following established methods with this task (Brown et al., 2017). See **Figure 1** for the distribution of this measure.

Clinical Measures for Caregivers and PWDs

Caregiver mental health. Within a month following the emotional assessment at UCB, participants completed online questionnaires at home that were selected to measure severity of

mental health symptoms. Caregivers reported on their depression symptoms for the past week using the Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977). Caregivers rated themselves on a four-point scale from 0 (“rarely or none of the time”) to 3 (“most or all of the time”) for 20 items (e.g., “I felt sad”, “I felt lonely”). Four items were reverse scored and then all items were summed, with higher scores indicating greater levels of depression symptoms. The CES-D has been previously validated for measuring depression in older adults (Beekman et al., 1997; Haringsma, Engels, Beekman, & Spinhoven, 2004). Caregivers reported on their anxiety symptoms for the past month using the Beck Anxiety Inventory (BAI; Steer & Beck, 1997). Caregivers rated themselves on a four-point scale from 0 (“not at all”) to 3 (“a lot”) for 21 items (e.g., “Unable to relax”). Scores were summed, with higher scores indicating greater levels of anxiety symptoms. The BAI has demonstrated reasonable test-retest reliability and validity when used with individuals with anxiety disorders (Beck, Epstein, Brown, & Steer, 1988; Fydrich, Dowdall, & Chambless, 1992). Because the CESD and BAI were significantly correlated in our sample ($r = .68$, $t = 8.14$, $p < .001$, 95% CI [.54, .79]), a composite of caregiver mental health symptoms was computed by z-scoring the CESD and BAI and averaging these z-scores. Higher scores on the composite of mental health indicate greater severity of averaged depression and anxiety symptoms. See **Figure 1** for distribution for this measure.

PWD disease severity. At UCSF, the Clinical Dementia Rating Scale (CDR) was completed using a semi-structured interview by clinicians with caregivers (Morris, 1993). The CDR assesses functional performance in six domains: (1) memory, (2) orientation, (3) judgement and problem-solving, (4) community affairs, (5) home and hobbies, and (6) personal care. For each domain, a score is given ranging from 0 (none) to 3 (severe) based on a description of functioning. Scores in each domain are summed to create a composite score, ranging from 0 to 18, with higher scores indicating greater disease severity. This measure has been a useful staging measure for individuals with dementia (Morris, 1997; Williams, Storandt, Roe, & Morris, 2013), has been validated against neuropathology data (Berg, McKeel, Miller, Baty, & Morris, 1993), and demonstrates good reliability (Burke et al., 1988).

PWD cognitive impairment. At UCSF, the Mini-Mental State Examination (MMSE) was used to assess the severity and progression of cognitive impairment (Folstein, Folstein, & McHugh, 1975). This exam evaluates several domains of cognitive functioning: (1) orientation, (2) visuospatial construction, (3) language, (4) concentration or attention, (5) working memory, and (6) memory recall. A total score is calculated from summing correctly performed items. Scores range from 0-30, with lower scores indicating greater cognitive impairment. This measure has been useful in detecting dementia and staging disease course (O’Bryant, Humphreys, et al., 2008; O’Bryant, Waring, et al., 2008) and has good reliability and validity for grading cognitive impairment (Tombaugh & McIntyre, 1992).

Aims and Hypotheses

Aim 1. To determine the association between caregiver empathy and caregiver mental health.

Hypothesis 1a: Greater caregiver emotional empathy will be associated with worse caregiver mental health.

Rationale: The literature on empathy in professional care providers suggests that greater emotional empathy is associated with worse health and quality of care, whereas greater cognitive empathy is associated with better health and career outcomes (Decety & Fotopoulou, 2014). Because greater emotional empathy may lead caregivers to be emotionally overwhelmed and distressed by PWDs' suffering, greater caregiver emotional empathy will be associated with worse caregiver mental health. Because greater cognitive empathy appears to be positively associated with better care provider outcomes, greater caregiver cognitive empathy will be associated with better caregiver mental health; however, because previous research has found more links between cognitive empathy and career outcomes (rather than psychological health outcomes), this association was not expected to be significant.

Data Analysis: Statistical analyses used R Studio Version 1.0.143.

Linear analyses: First, zero order Pearson correlations were conducted between variables of interest (i.e., caregiver mental health and measures of caregiver cognitive or emotional empathy). Then, all analyses were conducted with appropriate covariates based on preliminary analyses. A linear regression was conducted with caregiver cognitive empathy measures (accuracy from recognizing emotions in the films and dynamic tracking task) as predictors and caregiver mental health (a composite of caregiver depression and anxiety symptoms) as the dependent variable. Another linear regression was with caregiver emotional empathy measures (physiological, behavioral, and self-reported emotional experience to a film depicting suffering) as predictors and caregiver mental health (a composite of caregiver depression and anxiety symptoms) as the dependent variable. These linear regressions determined whether caregiver cognitive empathy or caregiver emotional empathy independently relate to caregiver mental health. Analyses included data from 78 caregivers.

Curvilinear analyses: Curvilinear relationships between caregiver empathy and caregiver mental health were examined. Greater caregiver emotional or cognitive empathy could be associated with worse mental health if levels of empathy are very high (i.e., being too good at recognizing others' emotions or feeling extremely distressed in the face of others' distress) or if levels of empathy are very low (i.e., not being able to recognize others' emotions at all or not resonating with others' distress at all). Prior literature suggests that extremely high and low levels of cognitive empathy are associated with elevated depression (Tully, Ames, Garcia, & Donohue, 2016). Linear regression models including the caregiver empathy term (CE) with increasing n^{th} power as the predictors were compared to test for a curvilinear fit with caregiver mental health (CMH) as the dependent variable. The model with the lowest Akaike information criterion (AIC) term was considered the best fit for the data (Akaike, 1974). If models showed appropriate curvilinear fit, then covariates based on preliminary analyses were added to determine if curvilinear fit remains. Analyses included data from 78 caregivers.

Model 1: $\text{lm}(\text{CMH} \sim \text{CE})$

Model 2: $\text{lm}(\text{CMH} \sim \text{CE} + \text{CE}^2)$

Model 3: $\text{lm}(\text{CMH} \sim \text{CE} + \text{CE}^2 + \text{CE}^3)$

Model 4: $\text{lm}(\text{CMH} \sim \text{CE} + \text{CE}^2 + \text{CE}^3 + \text{CE}^4)$

Hypothesis 1b: The association between caregiver emotional empathy and caregiver mental health will be stronger than the association between caregiver cognitive empathy and caregiver mental health.

Rationale: Research on empathy in care providers suggests that greater emotional distance, while being aware of another person's emotions, is better for a care provider's well-being (Ekman & Halpern, 2015). If a caregiver is high *understanding* others' emotions and also in *sharing* others' emotions, having greater emotional empathy may still be worse for mental health for the caregiver because greater emotional empathy reduces the emotional distance from someone else's distress.

Data Analysis: Statistical analyses used R Studio Version 1.0.143. Analysis included covariates based on preliminary analyses. A linear regression was conducted with measures of both forms of empathy as predictors (i.e., emotional and cognitive) as predictors and caregiver mental health as the dependent variable. This determined (a) whether caregiver emotional empathy was a stronger predictor (higher standardized coefficient: β) of caregiver mental health than caregiver cognitive empathy. Analyses included data from 78 caregivers.

Hypothesis 1c: The relationship between caregiver empathy and caregiver mental health will remain significant when accounting for caregiver emotional reactivity or PWD cognitive empathy, separately.

Rationale: The ability to generate an emotional response could influence empathy, and vice versa. For example, a person's tendency to experience greater emotional responses may facilitate their ability to behave more empathically because their response helps them understand or feel how another person feels. Similarly, one's empathic ability to know or feel someone else's emotions could influence one's emotional response because tuning in to others' emotions may make a person feel a larger emotional response. Regardless of whether empathy influences emotional reactivity or vice versa, a tendency toward negative emotionality also appears to relate to worse caregiver mental health (Brodaty & Donkin, 2009; Safavi et al., 2015; Shim et al., 2012). Although greater empathy and emotional reactivity may both contribute to worse caregiver mental health, caregiver empathy will still be associated with caregiver mental health. Furthermore, previous research suggests that PWDs' impairments in cognitive empathy are associated with worse caregiver psychological well-being (Brown et al., 2017). While PWD factors in relation to caregiver mental health have been widely examined and established, caregivers' own emotional functioning and resources likely have a stronger relationship to their mental health because how caregivers respond to PWD behaviors may be more relevant to their psychological health than the problematic PWD behaviors themselves.

Data Analysis: Statistical analyses used R Studio Version 1.0.143. Measure(s) of caregiver empathy that was/were significantly associated with caregiver mental health from Hypotheses 1a and 1b were included in analyses for Hypothesis 1c. First, zero order Pearson correlations were conducted between caregiver mental health and measures of caregiver emotional reactivity or PWD cognitive empathy. Then, analyses were conducted with covariates based on preliminary analyses. A linear regression was conducted with caregiver empathy measures and caregiver emotional reactivity (physiological, behavioral, and self-reported emotional experience to the anticipated startle task) as predictors; physiological, behavioral, and self-reported emotional experience to the unanticipated startle task as covariates; and caregiver mental health as the dependent variable. Then a separate linear regression was conducted with caregiver empathy measures and PWD cognitive empathy (accuracy on the dynamic tracking task) as predictors and

caregiver mental health as the dependent variable. Analyses accounting for caregiver emotional reactivity included data from 58 caregivers, and analyses accounting for PWD cognitive empathy included data from 64 dyads.

Aim 2. To determine whether PWD diagnosis or caregiver gender moderates the relationship between caregiver empathy and caregiver mental health.

Hypothesis 2a: The relationship between caregiver empathy and caregiver mental health will be stronger for caregivers caring for a person with frontotemporal dementia (FTD) than other kinds of neurodegenerative diseases.

Rationale: Caregivers of PWDs with behavioral symptoms, which are typically seen in FTD, tend to fare worse (i.e., greater burden, psychological distress) than caregivers of PWDs with primary cognitive or functional symptoms, which are typically seen in Alzheimer's disease, corticobasal syndrome, or progressive supranuclear palsy (Matsumoto et al., 2007; Merrilees et al., 2013; Ornstein & Gaugler, 2012; Richard Schulz et al., 1995). Given our limited sample sizes for these different diagnostic groups, this analysis was exploratory and focused on our two largest groups (FTD: $n = 33$; Motor: $n = 25$). We predicted that caregivers who are high in empathy and are caring for individuals with FTD would have worse mental health than those who are high in empathy and are caring for individuals with motor diagnoses.

Data Analysis: Statistical analyses used R Studio Version 1.0.143. Measure(s) of caregiver empathy that were significantly associated with caregiver mental health from Aim 1 were included in this analysis. A diagnosis variable was dummy coded to account for an FTD diagnosis (FTD = 1, Motor diseases = -1). A moderation analysis was conducted to examine whether the relationship between caregiver emotional empathy and caregiver mental health is more positive for an FTD diagnosis than a Motor diagnosis in PWDs, including covariates based on preliminary analyses. Analysis included data from 58 dyads.

Hypothesis 2b: The relationship between caregiver empathy and caregiver mental health will be stronger for caregivers who are female compared to those who are male.

Rationale: Previous research on demographic factors that influence caregiver mental health outcomes has found that being a female caregiver is associated with greater strain and psychological morbidity (Brodaty & Donkin, 2009; Richard Schulz et al., 1995). Caregivers who are high in empathy and are female will have worse mental health than those who are high in empathy and are male. Given the present study's limited sample size to examine moderation by gender ($N = 78$), this analysis was exploratory.

Data Analysis: Statistical analyses used R Studio Version 1.0.143. Measure(s) of caregiver empathy that are significantly associated with caregiver mental health from Aim 1 will be included in this analysis. A caregiver gender variable was dummy coded (male = 0, female = 1). A moderation analysis was conducted to examine whether the relationship between caregiver emotional empathy and caregiver mental health is more positive for female caregivers than male caregivers, including appropriate covariates based on preliminary analyses. Analysis included data from 78 dyads.

Preliminary analyses to determine covariates

Because caregiver demographic variables (caregiver age: $r = -.19$, $t = -1.60$, $p = .11$, 95% CI [-.41, .05], caregiver gender (0 = male, 1 = female): $r = .18$, $t = 1.48$, $p = .14$, 95% CI [-.06,

.40]) were not significantly correlated with caregiver mental health in our sample, they were not included as covariates in our analyses.

Because PWD clinical variables (disease severity: $r = .37, t = 3.57, p < .001, 95\% \text{ CI } [.17, .55]$, cognitive impairment: $r = -.28, t = -2.50, p = .01, 95\% \text{ CI } [-.47, -.06]$) were significantly correlated with caregiver mental health in our sample, they were included as covariates in our analyses.

Preliminary power analyses

Given our relatively limited sample size and multiple measures of predictors (i.e., physiological, behavioral, and self-reported emotional experience responses for caregiver emotional empathy or emotional reactivity tasks), we conducted preliminary power analyses to determine if there was adequate power. With a maximum sample size of 78, a maximum of 7 predictors (to allow for multiple measures of predictors and covariates), alpha level = .05, and medium effect size of $f^2 = .20$ (Cohen, 1988), we computed power at .8. With a minimum sample size of 58, a maximum of 7 parameters, alpha level = .05, and medium effect size of $f^2 = .20$, we computed power at .62. Thus, our sample size was adequate to detect a medium-sized relationship between caregiver empathy and caregiver mental health when data were available for all 78 participants.

However, when including specific measures from certain tasks that are not available for all 78 participants (e.g., caregiver responses to acoustic startle, PWD empathic accuracy on a dynamic tracking task), our sample was underpowered for detecting a medium-sized relationship between caregiver empathy and caregiver mental health when accounting for measures of caregiver emotional reactivity ($n = 58, 7$ parameters, alpha level = .05, power = .62) or PWD cognitive empathy ($n = 64, 7$ parameters, alpha level = .05, power = .68).

For exploratory moderation analyses, the present sample was adequately powered for detecting a medium-sized relationship ($f^2 = .20$) between the caregiver gender*caregiver empathy term and caregiver mental health ($n = 78, 5$ parameters, alpha level = .05, power = .80) but underpowered for detecting a medium-sized relationship between the PWD diagnosis*caregiver empathy term and caregiver mental health ($n = 58, 5$ parameters, alpha level = .05, power = .70).

Results

Relationships between caregiver cognitive empathy and caregiver mental health

Preliminary zero order Pearson correlations revealed that neither caregiver accuracy on the emotion recognition task ($r = .13, t = 1.12, p = .27, 95\% \text{ CI } [-.10, .34]$) nor on the dynamic tracking task ($r = -.01, t = -.10, p = .91, 95\% \text{ CI } [-.23, .21]$) were related to caregiver mental health.

A linear regression was conducted with measures of caregiver accuracy on the emotion recognition task and on the dynamic tracking task entered as predictors, PWD disease severity and PWD cognitive functioning as covariates, and caregiver mental health symptoms as the dependent variable. Neither accuracy on the emotion recognition task ($t = .55, \beta = .06, p = .59$) or accuracy on the dynamic tracking task ($t = .64, \beta = .07, p = .52$) was related to caregiver mental health symptoms.

Curvilinear analyses were conducted to examine whether caregiver accuracy on either task was associated with caregiver mental health symptoms. No measures of caregiver accuracy

on either task showed curvilinear fit with caregiver mental health symptoms. That is for both tasks, AIC was lowest for linear models (emotion recognition: AIC = 224.05; dynamic tracking: AIC = 225.31).

Relationships between caregiver emotional empathy and caregiver mental health

Preliminary zero order Pearson correlations revealed that caregiver self-reported emotional experience to the film of suffering was associated with caregiver mental health symptoms, such that greater experience of negative and caring emotions was related to greater anxiety and depression symptoms in caregivers ($r = .29, t = 2.66, p = .009, 95\% \text{ CI } [.07, .48]$). See **Figure 2**. In contrast, caregiver physiological responses ($r = -.14, t = -1.24, p = .22, 95\% \text{ CI } [-.35, .09]$) and facial behavior responses ($r = -.07, t = -.61, p = .55, 95\% \text{ CI } [-.29, .16]$) to the film of suffering were not related to caregiver mental health symptoms.

A linear regression was conducted with caregiver physiological, facial behavior, and self-reported emotional experience to the film of suffering entered as predictors, PWD disease severity and PWD cognitive functioning as covariates, and caregiver mental health symptoms as the dependent variable. Greater experience of negative and caring emotions in caregivers was related to greater anxiety and depression symptoms in caregivers ($t = 2.80, \beta = .28, p = .007$). Caregiver physiological responses ($t = -.77, \beta = -.08, p = .44$) and facial behavior responses ($t = -.57, \beta = -.06, p = .57$) to the film of suffering were not related to caregiver mental health symptoms.

Curvilinear analyses were conducted to examine whether each type of response to the film of suffering was associated with caregiver mental health symptoms. No measures showed curvilinear fit with caregiver mental health symptoms. That is, AIC was lowest for linear models (physiological: AIC = 223.23; behavioral: AIC = 224.95; self-reported: AIC = 218.37).

Comparing caregiver empathy relationships with caregiver mental health

A linear regression was conducted with measures of caregiver cognitive empathy (accuracy on the emotion recognition task, accuracy on the dynamic tracking task) and caregiver emotional empathy (physiological, facial behavioral, and self-reported emotional experience to the film of suffering) as predictors, PWD disease severity and PWD cognitive functioning as covariates, and caregiver mental health symptoms as the dependent variable. We found that self-reported emotional experience to the film of suffering was the only measure associated with caregiver mental health symptoms ($t = 3.03, \beta = .31, p = .003$), whereas caregiver physiological responses to the film of suffering ($t = -.85, \beta = -.09, p = .40$), caregiver facial behavior responses to the film of suffering ($t = -.99, \beta = -.11, p = .32$), caregiver accuracy on the film emotion recognition task ($t = 1.14, \beta = .12, p = .26$), and caregiver accuracy on the dynamic tracking task ($t = 1.15, \beta = .12, p = .25$) were not related to caregiver mental health symptoms.

Examining the robustness of the relationship between caregiver emotional empathy and caregiver mental health

To further examine the robustness of the relationship between caregiver emotional empathy and caregiver mental health, additional analyses were conducted to account for the potential influence of caregiver emotional reactivity or PWD cognitive empathy on this relationship.

Accounting for caregiver emotional reactivity. Preliminary zero order Pearson correlations revealed that caregiver physiological responses ($r = .07, t = .52, p = .61, 95\% \text{ CI } [-$

.19, .32]), facial behavior responses ($r = .20, t = 1.55, p = .13, 95\% \text{ CI } [-.06, .44]$), and self-reported responses ($r = .12, t = .92, p = .36, 95\% \text{ CI } [-.14, .37]$) to the anticipated startle task were not independently related to caregiver mental health symptoms. A linear regression was conducted with caregiver self-reported responses to the film of suffering *and* caregiver physiological, behavioral, and self-reported responses to the anticipated startle task as predictors; PWD disease severity, PWD cognitive functioning, *and* caregiver physiological, behavioral, and self-reported responses to the unanticipated startle task as covariates; and caregiver mental health symptoms as the dependent variable. Caregiver self-reported responses to the film of suffering was still associated with caregiver mental health symptoms, such that greater self-reported experience of negative and caring emotions to the film of suffering was associated with greater caregiver depression and anxiety symptoms ($t = 2.40, \beta = .30, p = .02$). Physiological responses ($t = .53, \beta = .06, p = .60$), facial behavioral responses ($t = 1.40, \beta = .20, p = .17$), and self-reported responses ($t = .15, \beta = .08, p = .57$) to the anticipated startle task were not associated with caregiver mental health symptoms.

Accounting for PWD cognitive empathy. A preliminary zero order Pearson correlation revealed that PWD accuracy on the dynamic tracking task was not significantly related to caregiver mental health symptoms ($r = .19, t = -1.56, p = .12, 95\% \text{ CI } [-.41, .05]$) but showed a positive relationship (albeit insignificant) with caregiver mental health symptoms similar to previous findings (i.e., worse accuracy on the dynamic tracking task in PWDs is related to greater depression and anxiety in caregivers; Brown et al., 2017). A linear regression was conducted with caregiver self-reported responses to the film of suffering *and* PWD accuracy on the dynamic tracking task as predictors, PWD disease severity and PWD cognitive functioning as covariates, and caregiver mental health symptoms as the dependent variable. Caregiver self-reported responses to the film of suffering was still associated with caregiver mental health symptoms, such that greater self-reported experience of negative and caring emotions to the film of suffering was associated with greater caregiver depression and anxiety symptoms ($t = 2.65, \beta = .29, p = .01$). PWD accuracy on the dynamic tracking was not related to caregiver mental health symptoms ($t = .52, \beta = .06, p = .61$).

Moderation of the relationship between caregiver emotional empathy and caregiver mental health by PWD diagnosis or caregiver gender

PWD FTD diagnosis. A linear regression was conducted with caregiver self-reported responses to the film of suffering, PWD diagnosis (FTD = 1, Motor diseases = -1), and an interaction term (caregiver self-reported responses to the film of suffering x PWD diagnosis) as predictors; PWD disease severity and PWD cognitive functioning as covariates; and caregiver mental health symptoms as the dependent variable. The interaction term was not associated with caregiver mental health symptoms ($t = .58, \beta = .02, p = .57$); thus, diagnosis (FTD versus Motor) did not moderate the relationship between caregiver self-reported responses to the film of suffering and caregiver depression and anxiety symptoms.

Caregiver gender. A linear regression was conducted with caregiver self-reported responses to the film of suffering, caregiver gender (male = 0, female = 1), and an interaction term (caregiver self-reported responses to the emotional empathy task x caregiver gender) as predictors; PWD disease severity and PWD cognitive functioning as covariates; and caregiver mental health symptoms as the dependent variable. The interaction term was not associated with caregiver mental health symptoms ($t = .74, \beta = .02, p = .46$); thus, caregiver gender did not

moderate the relationship between caregiver self-reported responses to the film of suffering and caregiver mental health symptoms.

See **Figure 3** for scatterplots between caregiver self-reported responses to the film of suffering and caregiver mental health symptoms by diagnosis (FTD vs. Motor) or gender (female vs. male).

Discussion

Caregivers of persons with neurodegenerative diseases are at heightened risk for declines in mental health as they deal with the burdens and stressors of caring for a loved one with progressive decline in functioning (Brodaty & Donkin, 2009; de Vugt & Verhey, 2013; Richard Schulz et al., 1995). However, there is significant variability in caregivers' vulnerability to the negative effects of caregiving. Although prior studies have examined PWD factors and caregiver demographics, resources, personality, and coping strategies, very few studies have examined how individual differences in caregivers' emotional functioning relates to their own mental health. Even fewer studies have measured caregivers' emotional functioning using laboratory-based assessments in relation to caregiver mental health (Wells et al., 2019; Wells, Hua, Levenson, in prep.). One understudied aspect of emotional functioning in caregivers is empathy, which is a core component of interpersonal functioning. When professional caregiver providers (e.g., physicians, nurses) have greater cognitive empathy (*understanding* others' emotions), they tend to experience better psychological and career outcomes (Decety & Fotopoulou, 2014; Decety et al., 2014; Gleichgerrcht & Decety, 2013; Halpern, 2003). In contrast, when professional care providers have greater emotional empathy (*sharing* others' emotions), their well-being declines and they are less effective at providing care (Decety & Fotopoulou, 2014; Decety et al., 2014). Moreover, one study found that caregivers who reported having higher cognitive empathy have greater life satisfaction, whereas those with reported higher emotional empathy have lower life satisfaction (Lee et al., 2001).

The present study examined objective, laboratory measures of cognitive empathy and emotional empathy in caregivers of persons with neurodegenerative diseases in relation to caregiver mental health. First, caregivers with greater emotional empathy were expected to have worse mental health. Second, caring for a person with FTD diagnosis (compared to a person with a Motor diagnosis) or being a female caregiver (compared to being a male caregiver) was expected to show a stronger relationship between greater caregiver emotional empathy and worse caregiver mental health. By using laboratory measures of empathy, the present study is the first study to link laboratory-based measures of empathy in caregivers of persons with neurodegenerative disease with caregiver mental health.

Consistent with the primary hypothesis, results revealed that the more caregivers reported experiencing negative and caring emotions to a film of suffering, the more depression and anxiety symptoms they reported within a month following the laboratory assessment. Importantly, this relationship remained stable regardless of caregiver physiological responses to the film, caregiver behavioral responses to the film, caregiver levels of emotional reactivity, or levels of cognitive empathy, disease severity, or cognitive functioning in the persons in their care. In contrast, measures of caregiver cognitive empathy were not related to caregiver mental health. No measures of caregiver empathy showed a curvilinear relationship with caregiver mental health. Contrary to the secondary hypotheses, neither PWD diagnosis nor caregiver

gender moderated the relationship between caregiver emotional empathy and caregiver mental health.

Relationships between empathy and mental health in caregivers

The current findings suggest emotional empathy as a potential vulnerability to poor mental health in caregivers of persons with neurodegenerative disease. Greater emotional empathy in caregivers (i.e., reporting more negative and caring emotions in response to others' distress) was associated with higher levels of depression and anxiety symptoms in caregivers. Interestingly, only reported emotional experience in response to the film of suffering (but not physiological or behavioral responses) were related to caregiver depression and anxiety symptoms. Physiological and behavioral responses to the film of suffering actually showed negative (albeit insignificant) relationships with caregiver depression and anxiety symptoms (See **Table 2**). Moreover, physiological, behavioral, and self-reported emotional experience were not correlated with each other, a finding that has been demonstrated in several other studies (Evers et al., 2014; Reizenzein, Studtmann, & Horstmann, 2013). Reporting emotional experience encompasses interpretation of the emotionally-relevant context and assigning emotional meaning. Although speculative, caregivers who assign others' distress as relevant to them (i.e., requiring a negative and caring emotional response) may have difficulty separating themselves from the situation. Thus, over time, as caregivers continue to share in the distress of their loved ones, they may experience more depression and anxiety.

Although prior literature suggests that greater cognitive empathy in professional care providers is related to better psychological outcomes by increasing emotional distance, or increasing focus on how the distressed other feels instead of sharing in the distress (Cusi, MacQueen, Spreng, & McKinnon, 2011; Ekman & Halpern, 2015; Halpern, 2003; Lee et al., 2001), the present study did not find evidence that greater cognitive empathy was particularly beneficial for caregiver mental health, even though most caregivers did well on both cognitive empathy tasks (**Figure 1**). There are multiple ways to interpret this null finding. One possibility is that caregivers may not benefit from having high levels of cognitive empathy if they already have high levels of emotional empathy. That is, caregivers experiencing greater distress in response to others' distress may not reap the potential benefits of adequate emotional distance or accuracy in recognizing others' emotions, resulting in feeling overwhelmed. Another possibility is that we measured recognition of emotions in *unknown* others, which may not generalize to recognition of emotions in their loved ones. Given the long history caregivers share with the persons in their care, asking caregivers to accurately recognize the emotions of the persons in their care might be a more relevant measure of cognitive empathy. It should be noted that the present study's emotional empathy measures were also in response to unknown others. However, it is possible that caregivers may be biased when understanding PWDs' emotions and that more accurate understanding of PWDs' emotions, specifically, relate to better caregiver mental health. To fully understand which aspects of empathy relate to caregiver mental health, future research should examine caregiver cognitive empathy and emotional empathy responses to persons in their care in relation to caregiver mental health.

There were no curvilinear relationships between empathy and mental health symptoms in the present study. Although findings did not reveal a good fit for curvilinear models, "too little" or "too much" emotional or cognitive empathy still may not be beneficial for caregivers. A self-report study in 201 caregivers found that there was a negative quadratic relationship between cognitive empathy and depression and a positive linear relationship between emotional empathy

and anxiety; in 187 non-caregivers, positive quadratic relationships were found between cognitive empathy and depression, emotional empathy and anxiety, and emotional empathy and depression (Jütten, Mark, & Sitskoorn, 2019). These findings suggest that the expected positive quadratic relationships between empathy and mental health is less relevant to caregivers. Furthermore, it is possible that the present sample did not encompass the full range of functioning for emotional and cognitive empathy—the majority of caregivers endorsed negative and caring emotions in response to the film and recognized others’ emotions accurately (**Figure 1**)— and thus no curvilinear relationship was found between empathy and mental health symptoms.

The present findings build upon studies examining individual differences in vulnerability to the negative effects of caregiving by measuring caregivers’ *own* emotional functioning as it relates to caregiver mental health outcomes. Our study also extends the empathy and health literature by showing that too much of a ‘good’ thing (i.e., being emotionally empathic) in a stressful context (i.e., caring for a loved one with a neurodegenerative disease) may have critical negative consequences.

Robustness of emotional empathy

Accounting for caregiver emotional reactivity or PWD cognitive empathy did not change the relationship between caregiver emotional empathy and their mental health. Prior research has found that dispositional emotional reactivity and emotional empathy influence each other (Davis, 1983; Rueckert, Branch, Rueckert, Branch, & Doan, 2011) and that a tendency to experience negative emotions may make caregivers more vulnerable to negative mental health outcomes (Brodaty & Donkin, 2009; Safavi et al., 2015). The present study suggests that, for caregivers, greater emotional empathy responses to *others’* distress may be *more* important for their depression and anxiety symptoms than their tendency to have greater responses to negative or aversive situations. Measurement of two aspects of emotional functioning (emotional reactivity and emotional empathy) in relation to caregiver health helped determine this level of specificity. Additionally, a study from our laboratory showed that when caregivers were “receivers” of poor cognitive empathy from their PWDs, the caregivers had worse mental health (Brown et al., 2017). The present study’s findings demonstrate how caregivers’ *own* capacity for emotional empathy, or how they respond to others’ distress, may be more related to their mental health than PWD levels of empathy. While research has established that several PWD characteristics influence caregiver vulnerability to poor mental health, our study highlights that caregivers’ individual differences in empathy may be a more important factor in their vulnerability. Regarding moderators, there was no evidence that an FTD diagnosis or caregiver female gender moderated the relationship between caregiver emotional empathy and mental health, despite what prior research would suggest (Brodaty & Donkin, 2009; De Vugt et al., 2006; Hsieh et al., 2013; Mourik et al., 2004; Pinquart & Sorensen, 2006).

The present study was underpowered for detecting a relationship between caregiver emotional empathy and mental health when accounting for caregiver emotional reactivity or PWD cognitive empathy. The study was also underpowered for detecting a moderating effect for PWD diagnosis. Despite the present study’s limited power in detecting the hypothesized finding and potential moderating effects, caregiver emotional empathy was strongly associated with caregiver mental health.

Causality

Because the present study utilized a cross-sectional design, findings raise important questions regarding the direction of influence. In other words, it is impossible to know whether caregiver emotional empathy influences caregiver mental health or vice versa. Indeed, similar associations between emotional empathy and mental health have been found in research for individuals with depression, anxiety, and other forms of psychopathology; individuals with more severe psychopathology symptoms show greater emotional empathy tendencies (O'Connor, Berry, Weiss, & Gilbert, 2002; Thoma, Schmidt, Juckel, Norra, & Suchan, 2015; Tibi-Elhanany & Shamay-Tsoory, 2011) and have trouble effectively regulating their emotional states (Sheppes, Suri, & Gross, 2015; Thompson, Uusberg, Gross, & Chakrabarti, 2019). Furthermore, if emotional empathy influences mental health, it is unclear whether trait or state levels of emotional empathy predict mental health symptoms. Caregivers who have higher trait emotional empathy may be particularly vulnerable to the negative effects of caregiving. Alternatively, the burdens of caregiving may create a stressful environment, which increases state emotional empathy in caregivers beyond their usual trait levels as they become more attuned to others' distress; subsequently, caregivers with increased state emotional empathy may become more depressed and anxious. Although emotional empathy and mental health processes are likely bidirectional, future research should examine caregiver emotional functioning and caregiver mental health longitudinally to elucidate causal influences.

Clinical Implications

Prior research suggests that optimal empathy allows for enough emotional distance between oneself and another's distress (Ekman & Halpern, 2015) and that too much emotional empathy might reduce this emotional distance (Lee et al., 2001). Theoretical and empirical evidence on empathy and emotion regulation suggest that emotional responses elicited as a function of empathy can be influenced by emotion regulation processes (Thompson et al., 2019; Zaki, 2014, 2019). Thus, specific emotion regulation strategies can be employed to reduce emotional empathy and increase emotional distance between oneself and another's distress. For example, caregivers might employ cognitive reappraisal, or alter their initial appraisals of the situation in a self and other-focused manner, to recalibrate the relevance of the PWDs' distress to themselves (i.e., they are not acting out to punish me; they cannot control their impulses). Caregivers might also employ attentional deployment, or control the way they attend to emotional cues, by attending to the situation but focusing less on the emotional features of the situation (i.e., they are having difficulty with their wheelchair; they want to be moved to the bed). It is important to note that the goal of using these emotion regulation strategies is *not* to help caregivers avoid or escape from the PWDs' suffering, which has been linked to poor caregiver health (Cooper et al., 2006), but to help caregivers reduce their negative emotional experiences in response to PWDs' distress. A meta-analysis of caregiver intervention research suggests that psychotherapeutic and psychoeducational interventions (more so than reducing amount of care provided by caregivers through adult day care, caregiver support groups that normalize burden and stress, and interventions to improve the PWD's memory or activity) showed the most consistent short-term effects on reducing caregiver burden and depression (Sorensen, Pinquart, & Duberstein, 2002). Future research should consider evaluating specific psychotherapeutic interventions that reduce emotional empathy through emotion regulation strategies in caregivers of persons with neurodegenerative disease.

Intervention studies that enhance cognitive empathy in community samples and health care professionals have found improved psychological outcomes such as decreased anxiety, depression, and burnout (Barbosa et al., 2013; Birnie, Speca, & Carlson, 2010; Lamothe, Rondeau, Malboeuf-Hurtubise, Duval, & Sultan, 2016). However, the present study found no evidence that cognitive empathy was associated with caregiver mental health. Although prior research indicates that improving cognitive empathy may be beneficial in community samples and health care professionals, the present study suggests that cognitive empathy may be a less promising intervention target for caregivers.

Strengths and Limitations

Strengths of this study include: examining the relationship between laboratory measures of caregiver cognitive and emotional empathy in relation to mental health in caregivers; including measures of physiological, behavioral, and self-reported emotional experience to assess emotional empathy responses; including multiple measures of cognitive empathy using dynamic stimuli that captured different aspects of recognizing others' emotions (accurate identification or continuous monitoring of others' emotions); examination of the strength of the relationship between caregivers' emotional empathy and their mental health when accounting for potential confounding measures (i.e., caregiver emotional reactivity and PWD cognitive empathy); testing potential moderators; and recruiting a heterogeneous group of PWD diagnoses that increases generalizability.

Limitations of the study include: using a cross-sectional design that limits ability to determine whether greater emotional empathy causes worse mental health in caregivers or vice versa; unequal distribution of PWD diagnoses; and lack of generalizability to non-European American or non-spousal caregivers. Future longitudinal research with a larger, more diverse sample would help remedy these limitations. Specifically, to determine if emotional empathy influences mental health in caregivers, an intervention study that decreases emotional empathy (by increasing psychological distance from the emotionally-salient situation) in caregivers might be valuable.

Conclusions

The present study examined the relationships between cognitive and emotional empathy and mental health in familial caregivers of persons with neurodegenerative disease. The present findings indicate that greater emotional empathy, at the level of self-reported emotional experience, in caregivers is associated with worse mental health in caregivers. Poor mental health in caregivers has significant costs for caregivers and the persons in their care. For example, caregivers have a greater mortality risk as they navigate the burdens and stressors of caregiving (Schulz & Beach, 1999), and research has shown that poor mental health in caregivers predicts shorter survival in persons with neurodegenerative disease (Lwi et al., 2017). Identifying factors that influence caregiver vulnerability to poor mental health can help to identify potential intervention targets. By helping caregivers increase emotional distance in response to the distress of the person in their care, it may be possible to reduce their mental health problems, thus improving quality of life for both caregivers and their loved ones.

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Table 1*Sociodemographic characteristics and clinical variables.*

Means and standard deviations provided, unless otherwise noted.

	PWDs	Caregivers
<i>N</i> =	78	78
Age	62.60 (8.69)	64.52 (9.26)
Gender (% Female)	43.3	60.3
Race (%)		
American Indian/Alaska Native	2.6	0
Asian/Asian American/South Asian	5.1	5.9
Black/African American/Afro-Caribbean	1.3	1.5
Latino/Chicano/Hispanic	5.1	2.9
Multi-racial/Other	3.8	4.4
Native Hawaiian/Pacific Islander	1.3	0
White/Caucasian/European American	80.8	85.3
Diagnosis (<i>n</i> =)		
FTD	33	-
AD	11	-
Motor	25	-
MCI or family member of person with FTD	9	-
Caregiver Relationship to the PWD (% Spouse)	-	92.3
CDR	3.96 (2.71)	-
MMSE	24.82 (4.81)	-
BAI	-	7.06 (7.60)
CESD	-	12.12 (9.24)

Notes. CDR and MMSE scores only available for PWDs. BAI and CESD only available for caregivers. CDR Box-Score = PWD disease severity; MMSE = PWD cognitive functioning; BAI = caregiver severity of anxiety symptoms; CESD = caregiver severity of depression symptoms

Table 2

Pearson correlation coefficients between measures of caregiver mental health (depression and anxiety), caregiver cognitive empathy (accuracy on films or tracking tasks), caregiver emotional empathy (responses to film of suffering), caregiver emotional reactivity (responses to unanticipated or anticipated startle tasks), and PWD cognitive empathy (accuracy on tracking task).

	<i>Accuracy</i>			<i>Film of Suffering</i>			<i>Unanticipated Startle</i>			<i>Anticipated Startle</i>			<i>PWD Accuracy</i>
	1	2	3	4	5	6	7	8	9	10	11	12	
1. Depression and anxiety		.1	-.01	-.2	.29*	-.07	.01	.15	-.1	.07	.17	.13	-.19
2. Accuracy (films)			.09	.1	-.2	.03	.13	.03	.1	.12	.11	.24	-.01
3. Accuracy (tracking)				.1	-.1	.13	.01	.16	-.1	-.02	-.04	.01	.24*
4. Physiological (suffering)					-.1	.09	.07	.01	-.1	.06	.09	-.09	.15
5. Self-reported (suffering)						0	.15	.22	-.2	.1	.1	-.25	.02
6. Facial behavior (suffering)							.06	-.01	.1	.01	-.23	.27*	-.18
7. Physiological (unanticipated)								.22	.1	.03	-.03	-.05	.05
8. Self-reported (unanticipated)									.1	-.08	.56***	.05	.15
9. Facial behavior (unanticipated)										.03	.01	.36**	-.02
10. Physiological (anticipated)											-.14	-.06	.11
11. Self-reported (anticipated)												.07	-.03
12. Facial behavior (anticipated)													-.15
13. PWD accuracy (tracking)													

* $p < .05$, ** $p < .01$, *** $p < .001$

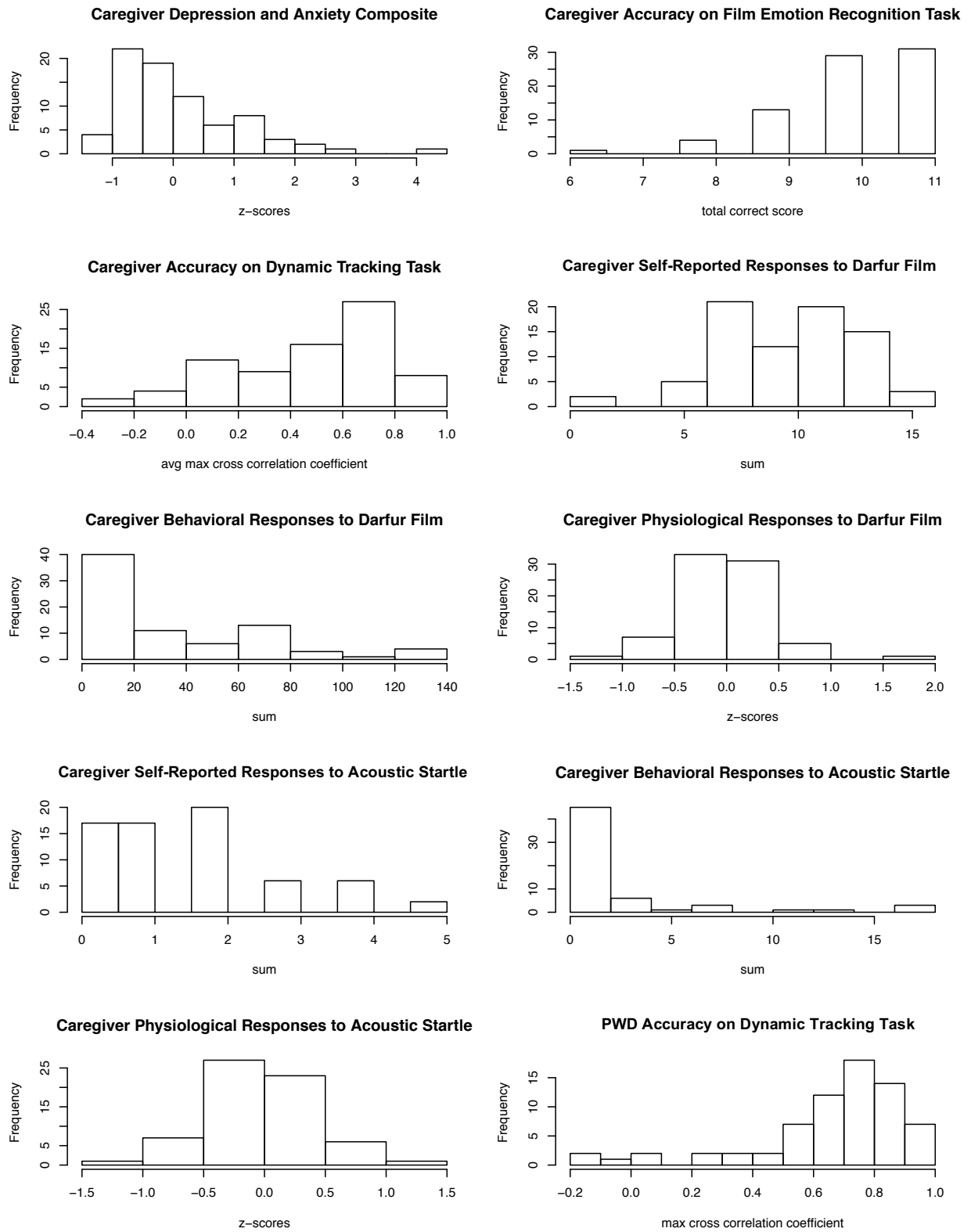


Figure 1. Distributions of measures.

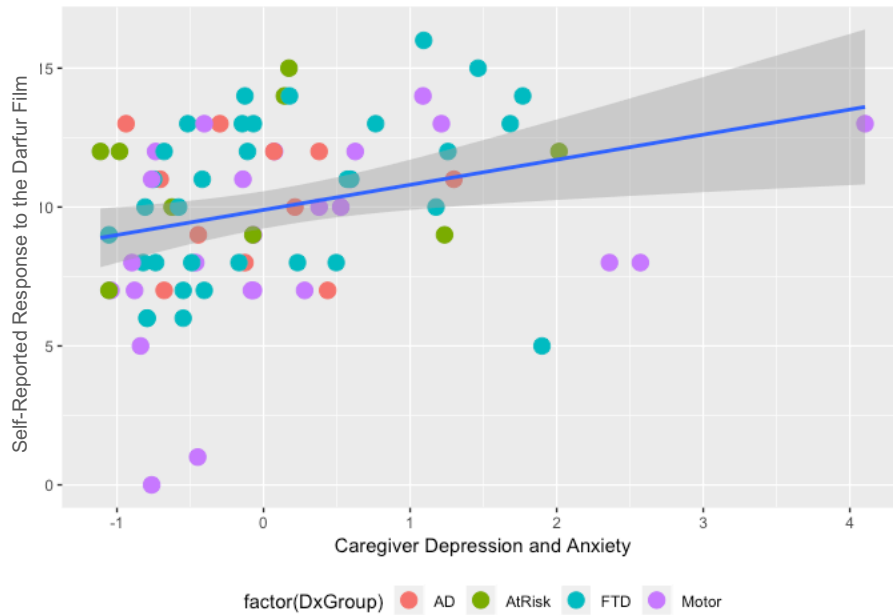


Figure 2. Scatterplot of the sum of intensity for self-reported emotional experience to the Darfur film and composite of caregiver depression and anxiety. The more that caregivers endorsed negative and caring emotions in response to the Darfur film, the more depressed and anxious they were. This relationship remained significant in a zero-order Pearson correlation and in linear regressions accounting for (a) PWD disease severity and cognitive functioning, (b) caregiver accuracy in recognizing emotions on the film task and on the dynamic tracking task, (c) caregiver physiological, behavioral, and self-reported responses to the anticipated acoustic startle task, or (d) PWD accuracy in recognizing emotions on a dynamic tracking task. *Note:* one caregiver had a depression and anxiety composite score greater than three standard deviations from the mean ($z = 4.03$). All results remained the same with or without this outlier.

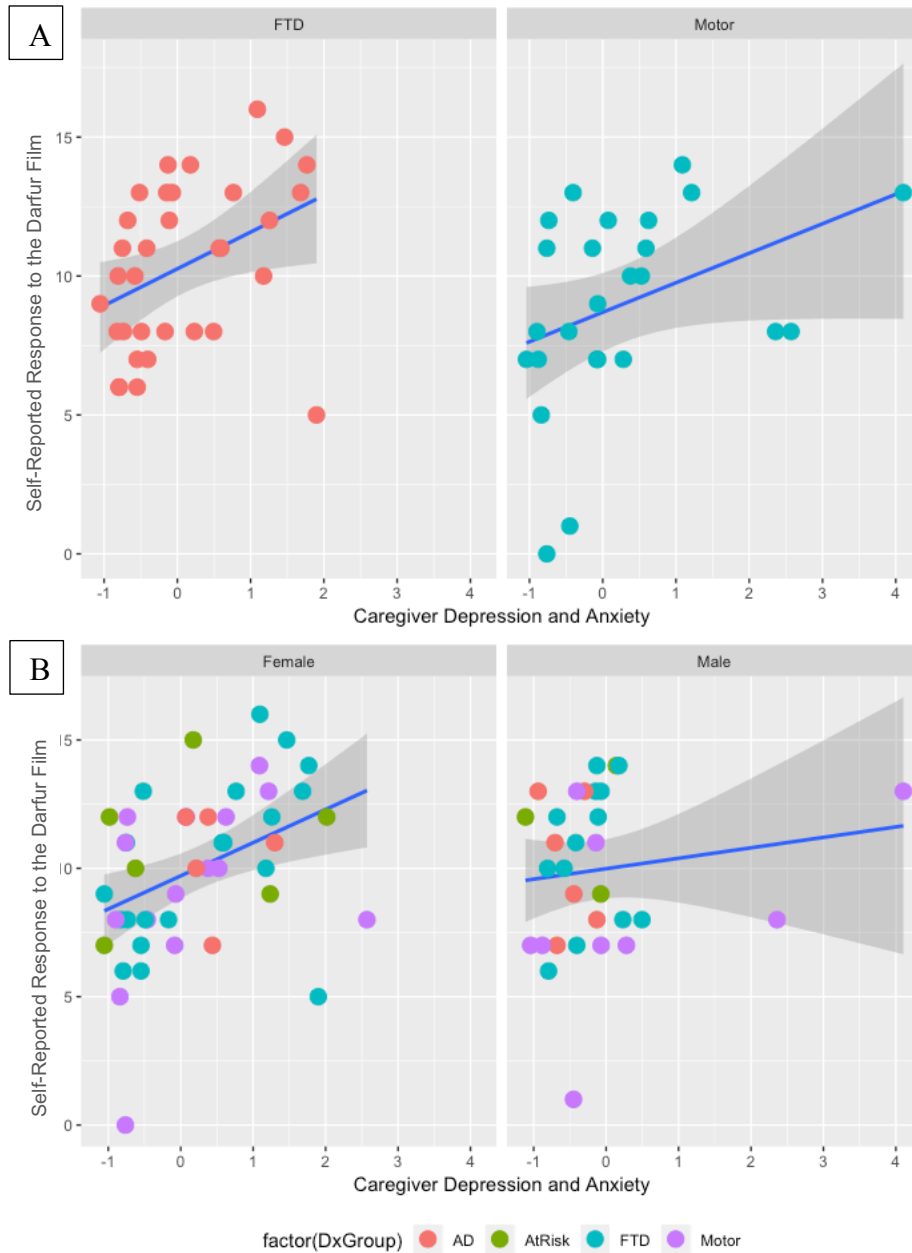


Figure 3. In panel A, PWD diagnosis of FTD (compared to Motor diagnoses) did not moderate the relationship between caregiver self-reported emotional experience to the Darfur film and caregiver composite of caregiver depression and anxiety. In panel B, across the whole sample ($n = 78$), caregiver gender did not moderate the relationship between caregiver self-reported emotional experience to the Darfur film and caregiver composite of caregiver depression and anxiety. *Note:* one caregiver had a depression and anxiety composite score greater than three standard deviations from the mean ($z = 4.03$). All results remained the same with or without this outlier.