Emotion

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Compassion is critical for societal wellbeing. Yet, it remains unclear how specific thoughts and feelings motivate compassionate behavior, and we lack a scientific understanding of how to effectively cultivate compassion. Here, we conducted 2 studies designed to a) develop a psychological model predicting compassionate behavior, and b) test this model as a mediator of a Compassion Meditation (CM) intervention and identify the "active ingredients" of CM. In Study 1, we developed a model predicting compassionate behavior, operationalized as real-money charitable donation, from a linear combination of self-reported tenderness, personal distress, perceived blamelessness, and perceived instrumental value of helping with high cross-validated accuracy, $r = .67$, $p < .0001$. Perceived similarity to suffering others did not predict charitable donation when controlling for other feelings and attributions. In Study 2, a randomized controlled trial, we tested the Study 1 model as a mediator of CM and investigated active ingredients. We compared a smartphone-based CM program to 2 conditions—placebo oxytocin and a Familiarity intervention—to control for expectancy effects, demand characteristics, and familiarity effects. Relative to control conditions, CM increased charitable donations, and changes in the Study 1 model of feelings and attributions mediated this effect ($p_{ab} = .002$). The Familiarity intervention led to decreases in primary outcomes, while placebo oxytocin had no significant effects on primary outcomes. Overall, this work contributes a quantitative model of compassionate behavior, and informs our understanding of the change processes and intervention components of CM.

Keywords: empathy, prosocial, placebo, loving-kindness meditation, desensitization

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> "Love and compassion are necessities, not luxuries. Without them, humanity cannot survive."—Dalai Lama XIV, *The Art of Happiness*

Compassionate responding to suffering others is critical for healthy social interactions, and is widely considered a virtue. Yet, how specific thoughts and feelings motivate compassionate behavior remains unclear, and we lack a scientific understanding of how to effectively cultivate compassion.

Here, we aimed to develop a model of the thoughts and feelings predicting compassionate behavior. We then tested this model as a potential mediator of a Compassion Meditation (CM) intervention in a randomized, longitudinal trial designed to investigate the active ingredients of CM.

Toward a Quantitative Model of Compassionate Behavior

Many models of compassionate behavior have been proposed (e.g., Ashar, Andrews-Hanna, Dimidjian, & Wager, in press; Charles Daniel Batson, 2011; Bennett, 2003; de Waal, 2008; Decety, 2011; Penner, Dovidio, Piliavin, & Schroeder, 2005; Zaki & Ochsner, 2012; Zaki, 2014). These models identify key processes underlying compassionate behavior (i.e., perspective-taking, affective resonance). Yet, these processes are often studied in isolation and are not combined into quantitative models of how much a person will help in a given situation. Here, we aimed to

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extend existing models by developing a quantitative measurement model predicting compassionate behavior.

Quantitative, predictive models have many advantages. Predictions provide a metric that can be used to benchmark a model's performance, providing stronger tests for how well we understand the factors motivating compassionate behavior. Quantitative models can also be directly compared on their predictive accuracy, providing an objective way to arbitrate between competing models of compassionate behavior (Yarkoni, Ashar, & Wager, 2015). Further, prediction may be useful in its own right; for example, in estimating how much charitable donation a charity fundraiser will net. Lastly, quantitative models provide a precise target that can be tested as a mediator of interventions designed to increase compassion.

In Study 1 ($N = 200$), we aimed to develop a quantitative, predictive model of compassionate behavior that could then be examined as a mediator of a compassion training program in Study 2. In both Studies 1 and 2, compassionate behavior was operationalized as real-money charitable donation: charitable donation is quantitative, parallels real-world helping opportunities, and is a costly form of helping requiring some sacrifice from the giver.

Our model of charitable donation focused on *feelings* and *attributions* regarding suffering individuals, due to converging behavioral and neural evidence for distinct affective and cognitive processes motivating helping behavior (Ashar et al., in press; Cox et al., 2012; Engen & Singer, 2013; Fan, Duncan, de Greck, & Northoff, 2011; Gonzalez-Liencres, Shamay-Tsoory, & Brüne, 2013; Raz et al., 2014; Reniers, Corcoran, Drake, Shryane, & Völlm, 2011; Shamay-Tsoory, Aharon-Peretz, & Perry, 2009; Zaki & Ochsner, 2012). We additionally included measures of perceived similarity in our model, as similarity has been shown to motivate helping behavior (Batson, Lishner, Cook, & Sawyer, 2005; Batson, Turk, Shaw, & Klein, 1995; Krebs, 1975; Loewenstein & Small, 2007; Oveis, Horberg, & Keltner, 2010), perhaps due to inferences regarding genetic overlap with the other (Cialdini, Brown, Lewis, Luce, & Neuberg, 1997; Hamilton, 1964) or to a sense of overlapping selves with the other (Aron, Aron, & Smollan, 1992).

An additional aim of Study 1 was to investigate the unique contribution of each feeling, attribution, and similarity to charitable donation. These variables have often been investigated in isolation, so their relative importance and their independent contributions to helping behavior are unclear. Indeed, some previous studies found that personal distress (Batson, Fultz, & Schoenrade, 1987; Eisenberg et al., 1989) and perceived similarity (Batson et al., 2005) no longer predicted helping behavior when accounting for other feelings.

Training Compassion

Recent research has highlighted Compassion Meditation (CM) and Loving-Kindness Meditation (LKM) as potentially valuable tools in the training of compassion. In these two related contemplative techniques, individuals mentally practice feeling kindness, benevolence, and compassion for others (Hofmann, Grossman, & Hinton, 2011). A small but growing body of evidence suggests that CM and LKM can increase compassion, self-compassion, and compassionate behavior, and can provide other personal benefits as well (for a recent review, see Galante, Galante, Bekkers, & Gallacher, 2014).

In spite of these promising findings, how CM- and LKM-based interventions work is still poorly understood. Specifically, it is unclear a) how CM affects specific psychological processes, leading to increased compassionate behavior, and b) whether the meditative component of a CM intervention is specifically responsible for observed effects. Study 2 ($N = 57$) was designed to address these questions in a randomized controlled trial.

Study 2 tested whether the Study 1 model of feelings, attributions, and similarity mediated the effects of a 4-week CM intervention on charitable donation. To date, no investigations of CM or LKM have linked changes in compassionate behavior with changes in specific psychological processes; this will be critical for advancing understanding of how these interventions work.

Further, to investigate the specific efficacy of CM's meditative component, we compared CM to two active interventions controlling for several nonspecific factors. The first intervention controlled for participant expectancies of increased compassion and demand characteristics (i.e., compliance with the perceived researcher objectives). We asked participants to inhale a placebo oxytocin nasal spray, which they were told would enhance their compassion. Although expectancy effects and demand characteristics have been associated with treatment responses across many domains (Adair, 1984; Wager & Atlas, 2015; McCambridge, de Bruin, & Witton, 2012; Orne & Whitehouse, 2000; Price, Finniss, & Benedetti, 2008), they have been relatively unexplored in the context of meditation interventions, with a small number of studies reporting mixed findings (Delmonte, 1981, 1985; Koopmann-Holm, Sze, Ochs, & Tsai, 2013; Woolfolk & Rooney, 1981; Zeidan, Johnson, Gordon, & Goolkasian, 2010).

Additionally, CM practice increases familiarity with suffering people. Since familiarity has been shown to increase liking (Zajonc, 2001), we hypothesized that it might be responsible for increases in compassion as well. To control for this, a second group of participants simply listened to biographies that described suffering individuals, without meditating upon them.

All three interventions—CM, familiarity, and placebo oxytocin nasal spray instructions—were delivered via smartphone applications, to investigate this format as a potential scalable dissemination mechanism for CM. Scalable dissemination may enable CM to benefit communities as a whole, a promising potential application of CM (Galante et al., 2014).

Study 1

Method

Participants. An unselected nationwide sample of 270 adults recruited through Amazon's Mechanical Turk completed Study 1 online in July of 2011. Participants were compensated $1 plus an additional $1 endowment to keep or donate as desired. Standard data quality control measures implemented for online surveys (Meade & Craig, 2012) resulted in the exclusion of one participant. Additionally, 69 participants did not donate on any trial, in keeping with nondonation rates observed in two in-lab pilot studies ($N = 25$ and 50, data not shown). These participants could not be analyzed—they had zero variance on the outcome of interest. Follow-up analyses suggested that these participants likely adhered to a no-donation policy despite reporting an emotional response otherwise sufficient to motivate donation (e.g., such

policies could be related to financial duress or negative beliefs about charities; see the online supplemental material and Figure S2). The exclusion of these participants limits generalizability to the nondonating population, but does not bias our findings with respect to the donating population.

The final sample included 200 participants (148 females, M_{age} = 33.5 years, SD_{age} = 12.3 years, 73% White, 9.5% Black, 7% Asian, 2.5% American Indian or Alaska Native, 4% Hispanic, 4% other). We targeted a sample size of $N = 200$ viable givers based on power estimates from two preliminary studies (data not shown). All procedures, including informed consent, were approved by the University of Colorado Institutional Review Board.

Procedure

Stimuli. Each participant viewed 16 unique randomly generated biographies describing an individual in need. Biographies were constructed by combining four sentences from a large pool of candidate sentences designed to induce variability on target psychological processes. Each biography was also paired with a randomly selected face photograph. Photographs were balanced on race (Black and White) and sex, identically sized, and selected from publicly available adult face-photograph databases, including the MUCT Face Database, the PICS database, and appropriately licensed images from Flickr Creative Commons (see Figure 1a for an example). In total, over 4,000 unique randomly generated biography–photograph configurations were presented to participants during the course of this experiment, out of a total possible ~280,000 biography–photograph configurations. This method of randomly combining a wide range of information relevant to the target psychological processes allowed for the decorrelation of the psychological constructs in our model, and further facilitated the generalization of results to novel stimuli (as in Study 2). Example biographies and photographs, and a description of the biography-generation algorithm, are included in the online supplemental material and Table S1.

Feeling, attribution, and similarity ratings. Participants rated each biography–photograph pair along six feelings, attributions, and forms of self-similarity (henceforth, FAS variables). Two feelings were measured—tenderness (feelings of warmth and softness toward the suffering individual) and personal distress (feeling upset or distressed regarding the suffering individual's situation)—as these two feelings distinctly influence helping behavior (Batson et al., 1987; Batson, 2011; Eisenberg et al., 1989). Two attributions regarding the suffering individual were measured: perceived blamelessness, and perceived instrumentality of helping (to what extent one's donation would substantively help the suffering individual), both of which have been linked to social behavior (Greitemeyer & Rudolph, 2003; Vroom, 1964). Lastly, two forms of perceived self-similarity were measured: the similarity of the participant's values and interests, and of their socioeconomic status (SES) to the suffering individual. Perceived similarity has been associated with increased helping behavior and is thought to underlie altruistic motivations (Batson et al., 2005; Cialdini et al., 1997; Hamilton, 1964; Oveis et al., 2010; Vollhardt & Staub, 2011).

Each FAS variable was assessed with three questions chosen a priori to measure the targeted construct, based on a pilot study ($N = 170$, data not shown). Questions (listed in online supplemental Table S2) were presented in random order following each stimulus on a 7-point Likert scale ranging from *strongly disagree* to *strongly agree*. Cluster analyses confirmed that the questions grouped according to the a priori constructs they were intended to measure (online supplemental Figure S1). Average responses across the three questions, for each of the six constructs, were used in regression analyses (see below).

Charitable donation. After providing ratings for the FAS variables, participants chose whether to donate money to each suffering individual from their endowment, selecting a value from \$0 to \$1 in 10-cent increments. To encourage participants to make independent choices on each trial, they were instructed that only one donation trial would be randomly selected, subtracted from their endowment, and donated.

Analyses

Multilevel multiple regression. A multilevel multiple regression assessed the relationship between charitable donation and each of the six feeling, attribution, and similarity (FAS) variables, controlling for other FAS variables. We regressed each FAS variable on donation amounts for each subject individually. Then, we computed a weighted average of the subject-level effect sizes, as well as 95% confidence intervals around those estimates using the unweighted subject-level estimates (Raudenbush & Bryk, 2002). Trials with missing data on any item were omitted from the subject-level models, and no second level (subject-level) predictors were entered.

Cross-validation. Cross-validation was used to estimate the model's ability to predict charitable donation amounts in new individuals. Cross-validation provides an unbiased estimate of model fit in individuals on whom the model was not trained. Conversely, failing to cross-validate yields inflated estimates of model fit (Hastie, Tibshirani, & Friedman, 2009). Across 10 different iterations, a multilevel GLM as described above was conducted with data from 9/10 of the participants, and the resulting model weights were used to predict charitable donation in data from the remaining 1/10 of the participants. This procedure yielded a predicted and an observed donation for every donation trial. We then calculated both the correlation and the absolute error between the predicted and the observed donations to estimate model fit. In order to predict relative donation amounts within person, we mean-centered the data within subject prior to analysis. This allowed us to test the model's accuracy in predicting how much a new individual would give on a single trial, given a) their FAS responses, and b) the normative model of FAS–donation relationships from other individuals. We conducted this analysis using custom MATLAB functions, which are freely available on the Wager lab website (http://wagerlab.colorado.edu/tools).

Results

Feelings and attributions predict donation. All four feelings and attributions—tenderness, personal distress, instrumentality, and blamelessness—significantly positively predicted charitable donation, even when controlling for all other feelings, attributions, and similarities ($ps < .05$, Figure 1b). In contrast, similarity's relationship with charitable donation—including similar values/interests and similar SES—was near zero and nonsignificant when controlling for other feelings, attributions, and similarities. However, post hoc analyses examining similar values/interests and similar SES in isolation, without controlling for any other predictors, indicated that both were positively related to donation, $ps < .0001$.

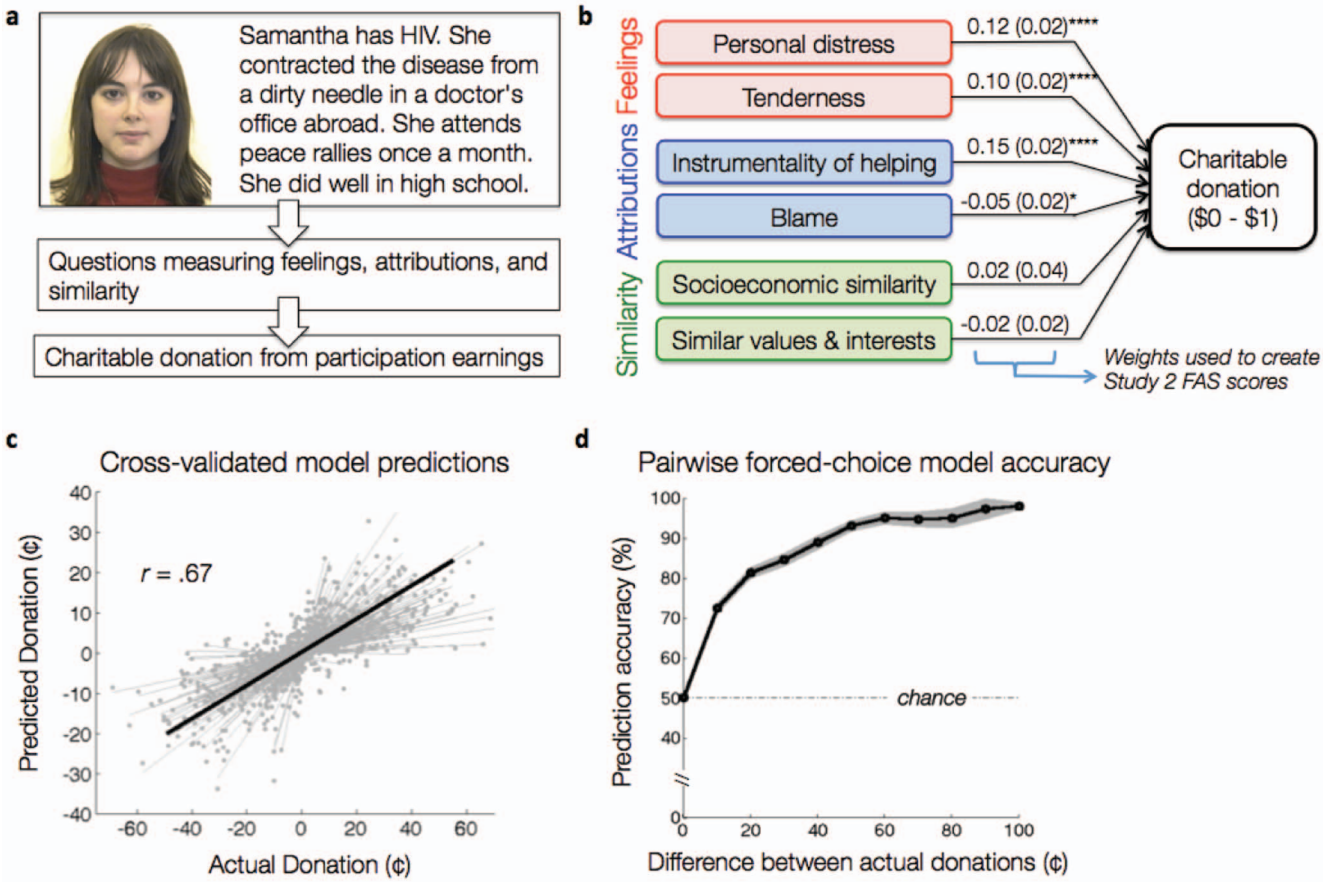

Figure 1. A model of charitable donation: Study 1 design and results. (a) Each participant viewed a unique set of 16 randomly generated biographies paired with randomly chosen photographs. Biographies were constructed from statements designed to influence target psychological processes. For each biography, participants reported their feelings toward, attributions about, and perceived similarity to the individual described in biography, and then optionally donated from their endowment. (b) In a cross-validated multilevel multiple regression, four feelings and attributions significantly predicted donation—even when controlling for all other feelings, attributions, and similarities—but two measures of similarity did not. In Study 2, these model weights were used to create Feeling-Attribution-Similarity (FAS) scores. The parameter estimate and standard error is listed next to each predictor. * $p < .05$, **** $p < .0001$. (c) The model's cross-validated predicted donations strongly correlated with actual donations (average subject $r = .67$, 95% CI = [0.64, 0.70]), explaining 45% of the variance in predicted donations. Each subject is represented by one gray line, representing the best fit between their predicted and actual donations, and four points corresponding to the quartile averages of their predicted and actual donations, mean-centered. The dark line indicates the group average. (d) In a forced choice test, the model predicted which ratings from a pair of ratings from a given subject would receive a larger donation. All predictions were made based on models trained on other participants (i.e., cross-validation), so that accuracy assessments were unbiased. When the true difference in donations was at least 50 cents, the model accuracy exceeded 90%. The shaded area represents the standard error of forced-choice accuracy across subjects. See the online article for the color version of this figure.

Model predicts donation amounts with high accuracy. Predicted donations strongly correlated with observed donations in a cross-validated analysis (see Figure 1c; average within-subject correlation of $r = .67$, 95% CI for within-subject correlations = [0.64, 0.70]). The mean absolute difference between predicted and observed donations was 13 cents, out of $1 possible. Further, in a forced choice test conducted for each subject using a model trained on other participants' data, the model predicted which of a pair of potential recipients would receive a larger donation with high accuracy, upward of 90% as the true difference in donations increased to 50 cents and greater (Figure 1d).

Discussion

Here, we developed a model quantitatively predicting charitable donations from six specific feelings, attributions, and measures of perceived similarity. Our model predicted charitable donation with high cross-validated accuracy. Feelings and attributions—includ-

ing tenderness, personal distress, blamelessness, and instrumentality of helping—all independently positively predicted charitable donation, even when controlling for other factors, while similarity did not. This support the view that empathy and compassion are multifaceted constructs, and that measuring both affective and cognitive processes (i.e., feelings and attributions) will be important for understanding compassion behavior (Ashar et al., in press; Fan et al., 2011; Shamay-Tsoory et al., 2009; Zaki & Ochsner, 2012).

Existing models of compassionate behavior generally identify key component processes (e.g., Ashar et al., in press; Charles Daniel Batson, 2011; Bennett, 2003; de Waal, 2008; Decety, 2011; Penner et al., 2005; Zaki & Ochsner, 2012; Zaki, 2014), but do not specify how these processes are integrated into a quantitative behavioral decision—that is, how much to donate. The quantitative, predictive approach taken here offers several advantages. Prediction affords a benchmark test of how well we understand compassionate behavior. Additionally, quantitative models can be directly compared on their predictive accuracy, providing objective means for arbitrating between competing models of compassionate behavior (Yarkoni et al., 2015). Further, prediction may be useful in its own right—for example, in estimating how much charitable donation a charity fund-raiser will net. And lastly, quantitative models provide a precise target that can be tested as a mediator of an intervention, as we do in Study 2 below.

The role of similarity in charitable donation. Similarity in values/interests and socioeconomic similarity predicted donation amounts only when examined in isolation, but not when controlling for other feelings and attributions. This directly accords with Batson's findings that the effect of similarity on empathy is minimized when accounting for associated changes in nurturing feelings (Batson et al., 2005). A sense of similarity may thus lead to helping behavior only if it also generates other prosocial feelings and attributions (i.e., more tenderness, less blame). Additionally, it may be that only specific forms of perceived similarity predict helping behavior, such as having suffered in highly similar ways (Vollhardt & Staub, 2011), in contrast to the more general forms of perceived similarity measured here. Overall, these findings challenge the notion that similarity is a key motivator of helping behavior (Krebs, 1975; Loewenstein & Small, 2007; Stotland, 1969).

The role of tenderness and personal distress. Both tenderness and personal distress significantly and positively predicted charitable donation when controlling for each other. This accords with previous research demonstrating that tenderness and personal distress are distinct, separable motivational processes (Batson, 2011). Yet, exactly how personal distress impacts helping behavior has been a matter of some debate. In one previous study, distress was *negatively* related to helping behavior, leading instead to escape behavior, while tenderness motivated helping behavior (Batson et al., 1987). In another study, distress was unrelated, negatively related, and positively related to helping behavior, depending on how constructs were operationalized, and with different patterns emerging in children and in adults (Eisenberg et al., 1989). And yet others have conceptualized distress relief as the primary motivator of helping behavior (Cialdini et al., 1987), though this perspective has been strongly challenged (Batson, 2011). Both our paradigm and our results most closely parallel Eisenberg's findings: Self-reported distress in adults positively predicts helping behavior, even when accounting for tender (or "sympathetic") feelings (Eisenberg et al., 1989). Distress is unpleasant to experience and may potentially lead to long-term reductions in helping behavior (Klimecki, Singer, & Oakley, 2012). However, our findings argue that distress promotes in-the-moment helping.

The relationship between personal distress and behavior is likely highly sensitive to context and individual differences. An intriguing hypothesis is that there might be a "Goldilocks" zone in which distress motivates helping, whereas too little or too much distress leads to apathy or avoidance. It also may be important to distinguish between other-oriented distress (feeling distressed for or about someone) and self-oriented distress (negative arousal without a sense of concern for the other; Batson et al., 1987; Batson, 2011; Eisenberg et al., 1989). Self-oriented distress may lead one to simply seek distress relief (either by escaping or by helping, whichever is easier), whereas other-oriented distress may lead primarily to helping. Given the subtle distinction between self-oriented and other-oriented distress, it will be important for future studies to focus on the measurement, manipulation, and differentiation of these and related constructs.

Study 2

In Study 2, we sought to investigate the cultivation of compassion. We conducted a randomized controlled trial designed to investigate the change processes and active ingredients of a Compassion Meditation intervention. We tested whether the Study 1 model of feelings, attributions, and similarities mediated effects of Compassion Meditation (CM) on charitable donation. We further investigated the active ingredients of CM by comparing it to two active controls: a placebo oxytocin condition, controlling for expectations of increased compassion and for researcher demand characteristics, and a Familiarity condition, controlling for increased familiarity with suffering others.

Method

Participants. Out of 311 participants screened for eligibility, 71 healthy adults completed the baseline assessment between January and September of 2012. To be eligible, participants were required to have no history of major psychiatric illness, no current mental health conditions, no previous experience with CM or LKM, and at least moderate interest in meditation: we sought to investigate the effects of CM among healthy, interested novices. A number of previous meditation trials have similarly excluded participants with meditation experience (e.g., Segal et al., 2010; Williams et al., 2014), although we are not aware of previous trials explicitly screening on meditation interest. We also did not enroll participants who indicated in advance that they would not make charitable donations, given our interest in the relationship between FAS scores and donation (see also online supplemental material for Study 1 and Figure S2). These exclusion criteria limit generalizability of our findings to the broader population, but do not bias results with respect to the population investigated.

Additionally, as this study included a neuroimaging component (fMRI data will be presented elsewhere), standard fMRI exclusion criteria applied: no metal in the body, normal hearing, normal or corrected-to-normal vision, no claustrophobia, women could not

be pregnant, and English was required to be a first language. We also screened out women who were breast-feeding, to maintain the oxytocin placebo deception. Lastly, 13 participants who completed the baseline assessment were not eligible for randomization for a variety of technical reasons (see online supplemental Figure S3), primarily excessive head motion during the baseline fMRI scan.

Fifty-eight participants were randomly assigned to a Compassion Meditation (CM) intervention, a placebo oxytocin (OxyPla) intervention or a Familiarity training intervention using a computer-generated randomization list, stratified by sex. Authors JS and YA conducted all assessments as well as the random assignment. They were blind to participants' intervention condition for the preintervention assessment but not for the postintervention assessment. Participant demographics and other baseline characteristics are provided in Table 1. One participant was excluded from analyses of donation amounts because she did not understand the donation task instructions.

Participants were compensated $100 for each session, and an additional $1 for each daily intervention task they completed. After completion of the study, OxyPla participants completed a questionnaire assessing the strength of their belief that they were actually taking oxytocin, and were then debriefed regarding the nature of the deception and its purpose. No participant reported being upset by the deception. The University of Colorado Institutional Review Board approved all procedures, including informed consent. No serious adverse events resulted from any of the intervention conditions.

Pre- and postintervention assessment of compassion and charitable donation. Identical assessments of compassion and charitable donation were administered pre- and postintervention, depicted in Figure 2a.

Biographies of suffering others. Participants listened to 24 randomly ordered biographies describing true stories of suffering individuals, such as orphaned children, adults with cancer, and homeless veterans (see online supplemental material for examples). Biographies were created from factual information posted on charity websites and recorded by one member of the research team as audio segments 26 to 33.5 s in duration. An authentic face photograph of each individual, also drawn from the charity website, was displayed while participants listened to that individual's biography. The individuals described in the biographies were balanced on age (child or adult), race (Black or White), and sex. Real stories and photographs were used to increase ecological validity.

Charitable donation task. Participants were given an option to donate a portion of their own experimental earnings to each of the 24 biographies, from $0 to $100 in $1 increments. Before they donated, participants were presented with an abbreviated audio-recorded reminder of each biography (8–11 sec). To encourage participants to make independent choices on each trial, they were informed that at the end of the experimental session, exactly one of their donations would be randomly selected, subtracted from their endowment, and donated to the organization that had helped the individual described in the biography ($2,800 was donated to charities as part of this study). Both the biography and donation tasks were completed in a functional MRI (fMRI) scanner; fMRI data will be presented in a separate manuscript.

Ratings of feelings, attributions, and similarity. Following the biography and donation tasks, participants listened to the full version of all 24 biographies a second time in a behavioral testing room. After each biography, participants answered six questions selected from Study 1 to measure each of the feelings, attributions, and similarities in the Study 1 model. These questions (listed in online supplemental Table S2) were presented in fixed order and answered on a visual analog scale ranging from *not at all* to *extremely*.

Expectations of intervention efficacy. After completing the baseline assessment, participants were randomized to an intervention condition. A member of the research team explained to the participant the nature of their intervention, and then assessed the strength of participants' expectations that the intervention would increase their compassionate feelings and behavior on an 11-point Likert scale.

Additional measures. Pre- and postintervention, participants completed several questionnaire measures of compassion-related constructs, an empathic accuracy task, and an audio experience sampling task. Details of measures administered, as well as results from questionnaire measures and the empathic accuracy task, are presented in the online supplemental material; experience sampling results will be presented in a separate manuscript.

Intervention design

Overview. The interventions were delivered via iPod Touch applications developed in-house and matched across conditions on

Table 1
Participant Characteristics

	CM	OxyPla	Familiarity
Sex: *n* female (% female)	14 (67%)	11 (61%)	11 (61%)
Age (years): *M* (*SD*)	28.72 (6.83)	27.43 (4.02)	29.63 (7.45)
Subjective SES	6.10 (1.71)	6.24 (1.56)	6.65 (1.50)
Race: *n* White (% White)	17 (81%)	15 (83%)	14 (78%)
Preintervention donation ($): *M* (*SE*)	17.90 (3.33)	24.97 (4.65)	25.63 (3.99)
Postintervention donation ($): *M* (*SE*)	19.62 (3.82)	20.74 (4.66)	19.18 (3.60)
Change in donation ($): *M* (*SE*)	1.72 (2.99)	−4.23 (3.52)	−6.45** (2.17)
Preintervention FAS score: *M* (*SE*)	24.99 (1.05)	25.65 (1.29)	26.21 (.95)
Postintervention FAS score: *M* (*SE*)	27.08 (1.11)	25.56 (1.13)	24.58 (.90)
Change in FAS score: *M* (*SE*)	2.08** (.66)	−.09 (.64)	−1.63* (.69)

Note. Subjective socioeconomic status (SSES) was measured by the MacArthur Scale of SSESS, a 10-point Likert scale ranging from lowest to highest SES (Adler, Epel, Castellazzo, & Ickovics, 2000). *T*-tests were conducted testing whether change in donation and change FAS scores differed from zero. CM = Compassion Mediation; OxyPla = placebo oxytocin; FAS = feeling-attribution-similarity.
* $p < .05$. ** $p < .01$.

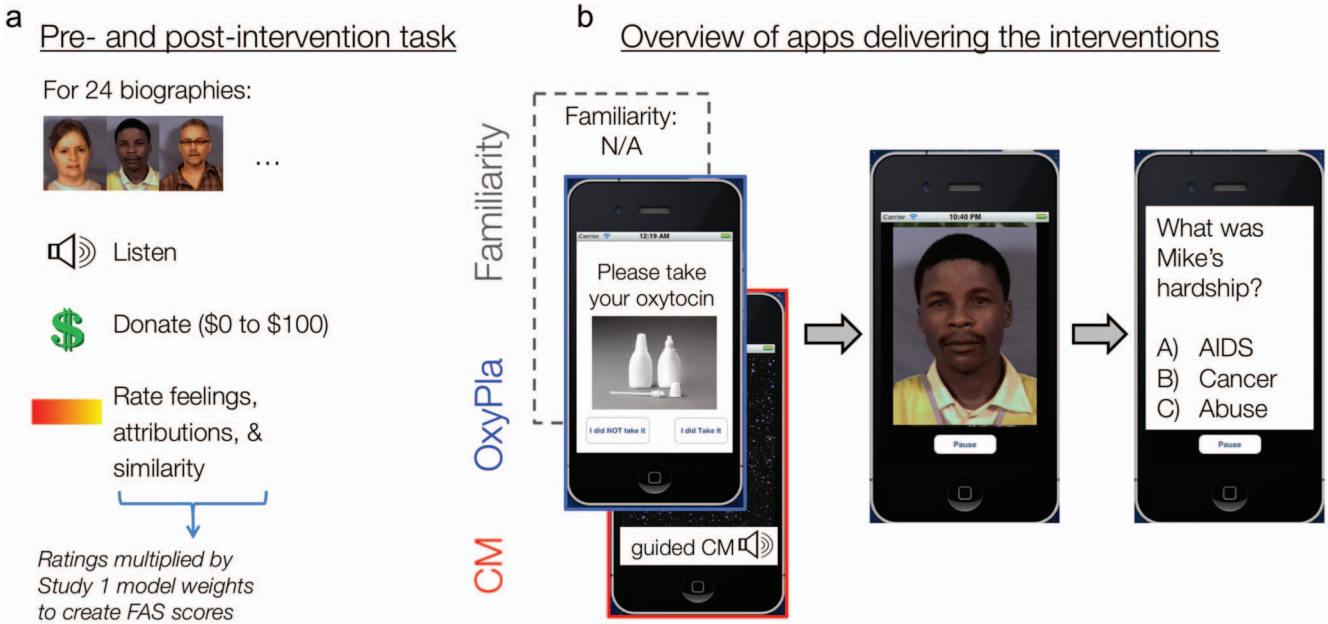

Figure 2. Study 2 design. (a) Pre- and postintervention, participants listened to 24 true biographies of suffering individuals while viewing a photograph of that individual, optionally donated to an undisclosed charity helping that individual, and then reported their feelings toward, attributions about, and perceived similarity to that individual. These ratings were multiplied by the Study 1 model weights (see Figure 1) to create feeling-attribution-similarity (FAS) scores, representing overall motivation to help. (b) Participants were randomized to one of three interventions—Compassion Meditation (CM), placebo oxytocin (OxyPla), and Familiarity—which were administered through closely matched smartphone applications. Each day, participants either listened to a guided Compassion Meditation, inhaled sham oxytocin, or did nothing (in the Familiarity condition). Then, they listened to the biography of a suffering individual pictured onscreen, and then answered an attentional check question regarding the biography. Photographs displayed in this figure are from an academic database: The photographs used in the study were of real individuals and are thus not displayed here. See the online article for the color version of this figure.

structure and style, as depicted in Figure 2b. All participants were asked to complete a daily task for 4 weeks on an iPod Touch provided to them. Authors JS and YA provided all participants with instructions regarding their intervention tasks and placed three phone calls to participants during the intervention to address any concerns, ask about side effects in the OxyPla condition, and encourage compliance.

In all three interventions, the daily task included listening to one of the biographies used in the charitable donation task while viewing that individual's photograph. Each participant listened to and viewed a set of 12 out of the 24 total biographies across the 4-week intervention period. The set of biographies was randomly assigned and balanced across groups.

Compassion meditation. Participants assigned to the CM intervention ($n = 20$) were instructed to listen to a 20-min guided meditation daily. Each week of the program featured a different meditation. These meditations, developed by author JH (see Halifax, 2012), were designed to progressively develop both sensitivity to others' suffering and equanimity in the face of suffering. These qualities are thought to facilitate compassionate responding without becoming emotionally overwhelmed or disabled by others' suffering (Halifax, 2012). During each guided meditation a biography was played, after which the meditation instructions asked participants to meditate on that individual specifically. A detailed description of the CM program is provided in the online supplemental material.

Placebo oxytocin intervention. Engaging in CM likely naturally creates expectations of increased compassion for many people. Further, completing a CM intervention in a research context creates demand characteristics: participants may feel pressure to satisfy the objectives and hopes of the research team, which are likely apparent. Rather than attempting to hide the purpose of the CM intervention (i.e., to increase compassion)—which may have been impossible—we chose instead to directly address this issue by including a placebo control group.

The OxyPla intervention was designed to control for these factors. Participants in this intervention ($n = 17$) were provided scientific information sheets describing oxytocin's ability to enhance compassion, and were instructed to inhale daily a nasal spray labeled as oxytocin. Immediately after inhalation, participants listened to a biography while viewing a photograph of that individual. To make demand characteristics explicit, these participants were told that the research team was interested in the effects of oxytocin on charitable donation and compassion.

Familiarity intervention. The Familiarity intervention was designed to control for the increased familiarity with suffering others. Participants in this intervention ($n = 18$) simply listened to

one of the biographies daily while viewing a photograph of that individual.

Daily attention-to-task check. After each daily task, participants in all conditions responded to a multiple-choice question designed to test whether they paid attention to the task. Participants were asked to indicate the primary hardship afflicting the individual described in the biography (e.g., What was Rob's primary hardship? a) AIDS, b) Cancer, or c) Homelessness). Additionally, after each daily task, participants completed a measure of mood (the PANAS short form; Watson, Clark, & Tellegen, 1988). Mood data will be presented in a separate manuscript.

Analyses

Group differences in FAS scores and charitable donation. We conducted two-sample *t* tests comparing group differences in pre-to-postintervention changes in a) feelings, attributions, and perceived similarity regarding suffering others and b) charitable donation. These tests were conducted on changes in participants' average scores across trials, for four planned comparisons: CM versus OxyPla, CM versus Familiarity, OxyPla versus Familiarity, and CM versus combined OxyPla and Familiarity conditions.

Feelings, attributions, and similarities were assessed with a composite measure (FAS scores), which was created by applying the regression weights from Study 1 to the measures collected in Study 2. FAS scores thus reflected the overall strength of the feelings, attributions, and perceived self-similarity most critical for motivating helping behavior. Although similarity was not a significant predictor of donation in Study 1 when controlling for other feelings and attributions, we nonetheless included similarity in Study 2 FAS scores. Similarity still contributed to the pattern of weights most predictive of donation, even if its contribution did not pass the threshold of statistical significance.

Effect sizes for FAS scores were estimated as Cohen's *d*, with exact confidence intervals calculated from a noncentral *t* distribution (Odgaard & Fowler, 2010). Effect sizes for donation were estimated in dollar amounts. There was no missing data for FAS scores. One participant was missing data for seven donation trials. No other donation data was missing.

Mediation analyses. We conducted a mediation analysis to test whether the identified feelings, attributions, and similarities could be a mechanism by which CM impacts helping behavior. We tested whether pre-to-postintervention changes in FAS scores formally mediated the effect of the interventions on pre-to-postintervention changes in charitable donation.

Since FAS scores and charitable donation were measured in the same experimental sessions, the temporal precedence of the mediator to the outcome variable could not be established. Additionally, because we analyzed relationships between observed FAS scores and observed donations (rather than manipulating either variable), we could not establish a causal relationship. Thus, positive results from this analysis would simply be consistent with the hypothesis that FAS processes are a causal mechanism through which CM impacts donation. We note, however, that this analysis was not purely cross-sectional, as it spanned two time points and controlled for baseline values in both the mediator and the outcome variable.

Path *a* tested the effect of intervention condition on pre-to-postintervention changes in FAS scores. Path *b* tested the effect of changes in FAS scores on changes in donation, controlling for intervention condition (see Figure 4). Paths *c* and *c'* tested the total and direct effect of intervention condition on donation. All effects and significance levels were calculated using bias-corrected, accelerated bootstrap tests with 10,000 samples (Efron & Tibshirani, 1994). Mediation tests were conducted for CM versus OxyPla, CM versus Familiarity, and CM versus combined OxyPla and Familiarity conditions, and were conducted using an in-house MATLAB mediation toolbox freely available on the Wager lab website (see online supplemental material; Wager, Davidson, Hughes, Lindquist, & Ochsner, 2008).

Examining feelings, attributions, and similarities individually. In secondary analyses, we conducted *t* tests and mediation analyses (as described above) on each of the feelings, attributions, and similarities individually, in order to investigate their independent intervention response. These analyses were conducted for the CM versus combined OxyPla and Familiarity comparison.

Results

Intervention compliance. Compliance, as logged by the intervention iPhone applications, was high across groups. CM participants completed their daily tasks significantly less frequently than other participants, perhaps due to CM's increased time and/or cognitive-emotional demands (out of 28 possible days, CM: M = 20.76 days (74%), 95% CI = [18.81, 22.71]; OxyPla: M = 26.78 days (95%), 95% CI = [25.38, 28.18]; Familiarity: M = 25.39 days (91%), 95% CI = [24.10, 26.68]; $F(2, 53) = 17.15$, $p < .001$). Performance on the daily attention-to-task questions was near ceiling across groups (CM: M = 95% correct, 95% CI = [0.93, 0.98]; OxyPla: M = 99% correct, 95% CI = [0.97, 1.00]; Familiarity: M = 100% correct, 95% CI = [0.99, 1.00]).

Participant expectations. Expectations of intervention efficacy were highest for the CM condition, followed by OxyPla, followed by Familiarity (CM: M = 5.97, 95% CI = [5.13, 6.82]; OxyPla: M = 5.16, 95% CI = [4.17, 6.14]; Familiarity: M = 3.68, 95% CI = [2.63, 4.73]). Expectations did not significantly differ between CM and OxyPla participants, but participants in both these groups had significantly higher expectations than Familiarity participants, confirming our intended manipulation of expectations. Expectations of intervention efficacy did not correlate with pre-to-postintervention changes in donation or in FAS scores, $r(49) = -.04$, $p = .80$ and $r(50) = .23$, $p = .10$, respectively. All CM and OxyPla participants reported at least some expectation of increased compassion, while two Familiarity participants reported zero expectation of increased compassion.

Feelings, attributions, and similarity (FAS) scores. CM participants' FAS scores significantly increased over time, OxyPla participants' FAS scores did not change over time, and Familiarity Participants FAS scores significantly decreased over time (Figure 3 and Table 1). CM participants' pre-to-postintervention increases were significant relative to the pre-to-postintervention changes in Familiarity and OxyPla participants, while Familiarity and OxyPla participants did not significantly differ in this respect (see Table 2). FAS scores did not differ by group at baseline, $F(2, 52) = 0.31$, $p = .73$.

Exploratory analyses on the individual feelings, attributions, and similarity measures found that CM participants increased on several of the individual FAS variables (notably tenderness, but not personal distress), OxyPla participants did not change on any of the individual FAS variables, and Familiarity participants decreased in personal distress specifically (see online supplemental Table S3).

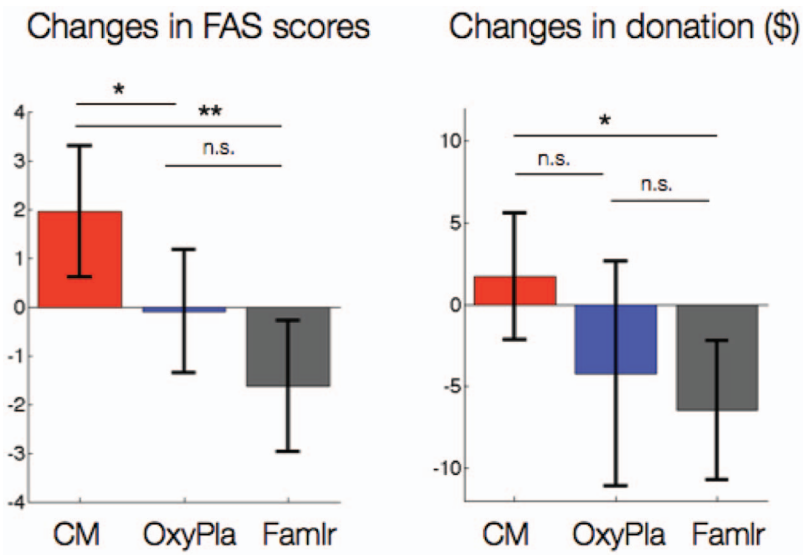

Figure 3. Pre-to-postintervention changes in feeling-attribution-similarity (FAS) scores and in charitable donation amounts. FAS scores reflect a composite measure of the feelings, attributions, and perceived similarity most motivating helping behavior, derived from the Study 1 model of charitable donation (see Figure 1). CM participants increased in FAS scores pre-to-postintervention, and had significantly different pre-to-postintervention changes in charitable donation relative to Familiarity participants. * $p < .05$, ** $p < .01$. CM = Compassion Meditation, OxyPla = placebo oxytocin, Famlr = Familiarity. Error bars are 95% confidence intervals. See the online article for the color version of this figure.

Charitable donations. Overall, participants donated an average of $21.57 per donation trial, out of $100 maximum. CM and OxyPla participants' donations did not change over the course of the intervention, while Familiarity participants' donations decreased (Figure 3 and Table 1).

CM participants' pre-to-postintervention changes in donation were significantly different from Familiarity participants and from the combined OxyPla and Familiarity participants. This was due to significant decreases in Familiarity participants, as well as to nonsignificant increases in CM participants. OxyPla participants did not significantly differ from either CM or Familiarity participants (Figure 3 and Table 2). Donations did not significantly differ by group at baseline, $F(2, 52) = 1.19$, $p = .31$.

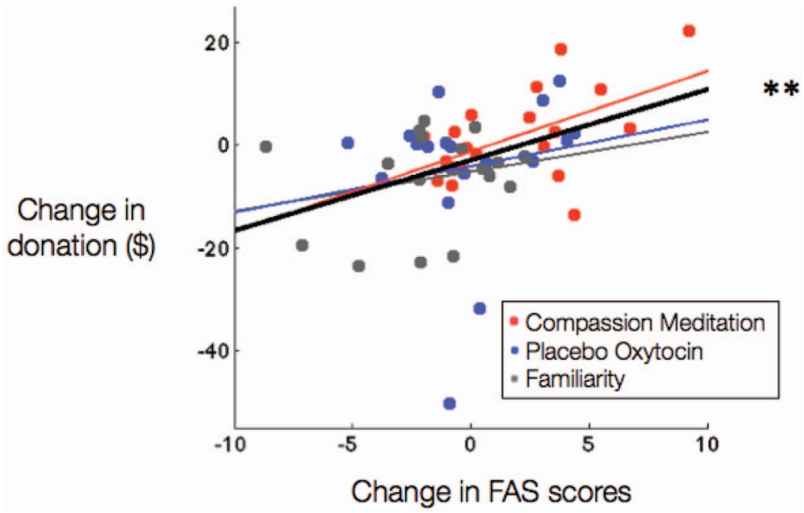

Figure 4. Pre-to-postintervention changes in feeling-attribution-similarity (FAS) scores were positively related to changes in charitable donation amounts, controlling for intervention condition (i.e., path *b* of mediation analysis). The overall correlation across all participants, indicated by the black line, was also significant, $r(54) = .38$, $p = .004$. See the online article for the color version of this figure.

Table 2
Effect Sizes for Group Differences in Pre-to-Postintervention Changes in FAS Scores and Charitable Donation Amounts

Comparison	Δ donation		Δ FAS scores	
	$	95% CI	Cohen's *d*	95% CI
CM vs. Familiarity	$8.17**	[$2.22, $14.11]	1.24**	[.58, 1.95]
CM vs. OxyPla	$5.95	[$−2.33, $14.23]	.75*	[.11, 1.41]
OxyPla vs. Familiarity	$2.21	[$−6.25, $10.68]	.54	[−.10, 1.18]
CM vs. combined OxyPla & Familiarity	$7.06*	[$1.34, $12.78]	1.00**	[.51, 1.82]

Note. FAS = feeling-attribution-familiarity; CM = Compassion Mediation; OxyPla = placebo oxytocin. 95% confidence interval (CI) provided in bracket.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Mediation results. Pre-to-postintervention changes in FAS scores statistically mediated the effect of the intervention on pre-to-postintervention changes in donation amounts. This held for all three CM comparisons: CM versus OxyPla, $\beta_{path\text{-}ab} = 1.36$, 95% CI = [0.20, 3.74], CM versus Familiarity, $\beta_{path\text{-}ab} = 2.04$, 95% CI = [0.60, 4.73], and CM versus combined controls, $\beta_{path\text{-}ab} = 1.07$, 95% CI = [0.32, 2.52]. Mediation was not tested for OxyPla versus Familiarity, because these groups did not significantly differ on either FAS scores or charitable donations. Full mediation statistics are provided in online supplemental Table S4, and Figure 4 depicts path *b* of the mediation analysis: the correlation between change in FAS scores and change in donation, controlling for group.

Individual feelings, attributions, and similarities. Secondary analyses, presented in online supplemental Tables S3 and S4, were conducted on the individual feelings, attributions, and similarities. These revealed significant group differences in pre-to-postintervention changes in tenderness, $M_{CM} - M_{combined} = 7.48$ (out of 100), 95% CI = [3.41 11.55], distress, $M_{CM} - M_{combined} = 8.20$ (out of 100), 95% CI = [0.25 16.16], and instrumentality of giving, $M_{CM} - M_{combined} = 6.60$ (out of 100), 95% CI = [1.82 11.38]. Group differences in tenderness and instrumentality were driven by pre-to-postintervention increases in CM participants, with no changes in OxyPla or Familiarity participants, while group differences in distress were driven by decreased distress in the Familiarity condition, with no changes in CM or OxyPla participants (online supplemental Table S3). Of the individual feelings and attributions, only distress mediated the effect of CM versus combined OxyPla and Familiarity on donation, $\beta_{path\text{-}ab} = 0.60$, 95% CI = [0.03, 1.66] (Table S4).

Discussion

Compassion is critical for personal and societal wellbeing and is widely considered a virtue. Yet, we do not know the extent to which specific thoughts and feelings motivate compassionate behavior, and we lack a scientific understanding of how to train compassion. Here, we conducted two studies designed collectively to advance our understanding of compassion and Compassion Meditation (CM).

In Study 1, we developed a model of six feelings, attributions, and perceived similarities that predicted charitable donation with high levels of cross-validated accuracy. We found that tenderness, personal distress, perceived blamelessness, and perceived instrumentality of giving all strongly and independently predicted charitable donation amounts when controlling for other factors, while similarity did not. This model also served as a precise psychological target that we could test as a mediator of the effects of CM on charitable donation in Study 2.

In Study 2, we investigated the psychological mechanisms of CM. Although CM has shown promise in enhancing compassion (reviewed in Galante et al., 2014), the specific psychological processes engaged by CM, and its active ingredients, remain unclear.

To investigate the specific psychological processes engaged by CM, we applied the Study 1 model weights to the feelings, attributions, and similarity ratings reported by participants in Study 2. This generated a "FAS" score for each participant at each time point—a single number representing the composite of feelings, attributions, and similarities most motivating donation—which we tested as a mediator of the interventions. To examine active ingredients, we conducted a randomized trial comparing CM to two active control interventions: a placebo oxytocin (OxyPla) intervention controlling for expectancy effects and demand characteristics, and a Familiarity intervention controlling for familiarity effects.

CM participants increased in FAS scores pre-to-postintervention, both in absolute terms and when compared to the two control conditions. This suggests that CM has a specific effect on FAS processes above and beyond expectancy effects, demand characteristics, and familiarity effects. CM participants also significantly differed from Familiarity participants on pre-to-postintervention changes in donation. However, this difference was driven primarily by decreased donation in Familiarity participants, rather than increased donation CM participants. Importantly, participant-level changes in FAS scores were correlated with changes in donation amounts, such that FAS scores mediated the effect of the interventions on charitable donation.

Overall, these results contribute to the growing evidence base that CM can increase compassion and may impact helping behavior (reviewed in Galante et al., 2014), and provide further insight into CM's psychological mechanisms. Below, we discuss implications for our understanding of how CM engages specific psychological processes to affect compassionate behavior, and for our understanding of CM's active ingredients.

Psychological mechanisms of Compassion Meditation. This is the first study of CM or Loving-Kindness Meditation to find correlated changes in both psychological and behavioral mea-

sures of compassion. Relating psychological processes to behavior will be critical for better understanding CM. Although much work remains to identify the mechanisms of change in CM, these results suggest that FAS processes are a plausible target for CM interventions seeking to increase helping behavior and a promising candidate of focus for future experimental research.

When examining the individual FAS component processes, one of the largest effects of CM was on tenderness. Tenderness robustly increased among participants assigned to CM, but not among participants assigned to control interventions. This concurs with multiple previous studies from independent investigators reporting that Loving-Kindness Meditation (LKM), a technique closely related to CM, increased positive affect in general and specifically for suffering individuals (Hutcherson, Seppala, & Gross, 2008; Klimecki, Leiberg, Lamm, & Singer, 2013; Kok et al., 2013). Taken together, this provides converging evidence that CM and LKM can increase tender, positive emotional responses to suffering others. Yet, FAS scores mediated the effect of the intervention more robustly than any individual feeling or attribution, indicating the value of models integrating multiple psychological processes for understanding the impact of complex interventions on behavior.

Effect of Compassion Meditation on behavior. CM did not lead to statistically significant increases in donation, despite increased FAS scores. We consider several potential reasons for this discrepancy between FAS scores and behavior.

Perhaps CM participants' increase in FAS scores was due to expectancy effects or demand characteristics, while donation was less susceptible to these effects due to its costly nature. However, OxyPla participants did not increase in FAS scores, suggesting that it was not due to these factors.

Another possibility is that participants may have experienced a natural tendency to donate less over time to the same recipients. Such a natural history would produce a downward trend in donation amounts over time across all groups, a pattern that is consistent with our results, and would diminish the ability to observe intervention effects. This downward trend may have affected only donation, because of its costly nature, and not FAS scores. However, we are not aware of any published studies with a repeated donation paradigm with which to test this hypothesis.

A finally intriguing hypothesis is that CM directly targets thoughts and feelings, not overt behavior, so CM may most strongly impact such thoughts and feelings. Interventions directly asking participants to engage in overt helping behaviors, such as spending money on others (Dunn, Aknin, & Norton, 2014), might show larger effects on such outcomes. In future studies, contemplative interventions seeking to impact overt behaviors might ask participants to practice imagining engaging in those behaviors (e.g., Pascual-Leone et al., 1995).

Finally, the relatively high between-subjects variability of donation amounts as compared to FAS scores attenuated statistical power to detect significant changes in donation as compared to FAS scores.

The role of expectancy effects and demand characteristics in Compassion Meditation. Engaging in CM will naturally create expectations of increased compassion for many people. Similarly, completing a CM intervention in a research context will likely create demand characteristics: participants may feel pressure to satisfy the apparent objectives of the research team to demonstrate increased compassion. The researchers' objective cannot be easily hidden from participants engaging in CM. Such expectancies and demand characteristics have been directly linked to treatment outcomes across a number of contexts (Wager & Atlas, 2015), so they must be controlled for. Yet, previous trials have compared CM to active controls that—despite many other strengths—may not have been adequately matched on compassion-related expectancies and demand characteristics (i.e., mindfulness meditation, health discussion group, or memory training control groups; Condon, Desbordes, Miller, & DeSteno, 2013; Klimecki et al., 2013; Pace et al., 2010; see also Boot, Simons, Stothart, & Stutts, 2013).

The OxyPla intervention used here, in which participants inhaled a sham nasal spray that they were told would increase their compassion, was explicitly designed to control for these factors. CM and OxyPla participants did not differ on a preintervention measure of expectations, while Familiarity participants had significantly lower expectations of increased compassion. Relative to OxyPla, CM increased FAS scores but not donation. This implies that CM is specifically efficacious in increasing compassion-related feelings and attributions (but not behavior) above and beyond expectancy effects and demand characteristics.

Overall, we found limited evidence for the effects of expectancy and demand characteristics on compassion and helping behavior. OxyPla participants did not change in either FAS scores or donations. Yet they did not decrease in these measures, like Familiarity participants, despite equivalent exposure to suffering others. The placebo may have had a null effect, or, may have prevented the decreases observed in the Familiarity condition. Further, participants' expectations of intervention efficacy did not correlate with pre-to-postintervention changes, across intervention conditions. It is thus possible that demand characteristics, rather than reportable expectations, may have primarily accounted for any placebo effects.

Placebo effects are often created through interpersonal processes; for example, by a doctor assuring a patient of expected improvement (Miller & Kaptchuk, 2008) or by social conformity effects (Koban & Wager, 2015). Yet, the ability of placebos to impact these same interpersonal processes is relatively unexplored. Better understanding placebo effects on interpersonal processes, as we sought to do here, will be especially important for advancing understanding of interventions with interpersonal outcomes (i.e., CM) and treatments of conditions with interpersonal deficits (i.e., social anxiety disorder).

The role of familiarity in Compassion Meditation. We expected that familiarization with suffering individuals might enhance compassion for them, given the body of work relating increased exposure to stimuli with increased liking (Zajonc, 2001), and some evidence suggesting that increased awareness of suffering others may lead to increased compassion (Stellar, Manzo, Kraus, & Keltner, 2012). Thus, we asked participants in the Familiarity condition to simply listen to a story of a suffering person each day of the intervention. Contrary to our expectations, Familiarity participants decreased both in FAS scores and in charitable donations. Possibly, this was caused by a process of desensitization, in which repeated exposure to suffering others lead to decreased compassion and helping. Familiarity participants may have thus "habituated" to others' suffering, leading to a decreased emotional and behavioral response. Examination of the individual FAS components further revealed that Familiarity participants

primarily decreased in personal distress, congruent with the desensitization hypothesis.

Does CM buffer against desensitization to suffering others? This pattern of changes in Familiarity participants stands in stark contrast to CM participants, who had an equivalent exposure to the suffering individuals and yet increased in FAS scores and did not decrease in donation. Perhaps, exposure to suffering individuals in the context of CM buffers against such desensitization. Indeed, a core practice of CM is to be open and engaged with others' suffering, rather than avoiding or numbing to others' suffering.

This has intriguing implications for the application of CM. It suggest that techniques like CM may be especially important for professions requiring continued compassion in the face of regular exposure to suffering (e.g., nurses; Halifax, 2011). Indeed, professional burnout has been estimated to afflict between 40 to 80% of professional caregivers (McCray, Cronholm, Bogner, Gallo, & Neill, 2008). Some work suggests that burnout may be caused by excessive distress (but not excessive tenderness) for suffering others (Batson et al., 1987; Klimecki et al., 2013). Congruent with this, we found that CM increased tenderness and did not increase distress, supporting the notion that CM may be beneficial for nursing and related professions (Halifax, 2011). Future studies designed explicitly to investigate the desensitization/burnout phenomenon will be needed to shed light on how repeated exposure to suffering, under certain conditions, can lead to a collapse of compassion (i.e., see Cameron & Payne, 2011; Klimecki & Singer, 2011), and how CM or other techniques might counteract this.

The challenge of designing appropriate control conditions for meditation. Designing credible, structurally equivalent controls is an important goal for meditation research (MacCoon et al., 2012). Our work here both underscores the challenge of this endeavor and offers some novel control conditions. We sought to develop a placebo intervention that was matched to CM with respect to expectancies and structure (i.e., daily practice, use of the smartphone app, listening to a daily story of suffering). Yet, the OxyPla condition was not matched on daily practice time. Moreover, it may have caused participants to misattribute genuine affect to the placebo, leading them not to act on it: OxyPla participants may have discounted experienced compassion as simply due to the oxytocin, disinclining them from donating (Wager & Atlas, 2015; Schwarz & Clore, 1983). Specially designed control interventions (Maccoon et al., 2012), sham meditation instructions (Zeidan et al., 2010), and placebo interventions (Segal et al., 2010) that are matched on expectancies and demand characteristics (Boot et al., 2013) will be critical for better understanding both the specific effects of meditation and the effects of expectancies.

Limitations. We only recruited participants who were interested in meditation and who were willing to charitably donate; this limits generalizability to people not receptive to meditation or unwilling to donate. Because of these inclusion criteria, the effects of CM reported here might be larger than one would expect to find in the broader population. Alternatively, nondonors and participants not receptive to meditation might show even more drastic effects of CM, as they may have relatively more potential for increasing in donation and compassion.

Additionally, nonsignificant baseline group differences in charitable donation amounts created conditions where regression to the mean may have potentially enhanced the effects of CM. However, participant-level changes in donation were correlated with changes in FAS scores, suggesting that changes in donation were in fact associated with changes in thoughts and feelings regarding suffering others. We recommend that future investigations stratify participants according to baseline donation amounts to ensure baseline equivalence among groups.

Implications and future directions for CM. The observed changes in FAS scores demonstrate the efficacy of the meditative component of CM to increase compassion, over and above familiarity effects, expectancy effects, and demand characteristics. Yet, CM did not have a large effect on helping behavior (donation). However, even small changes in compassionate behavior can have a powerful societal impact if disseminated on a broad scale (i.e., potentially, by smartphone apps).

The largest effects of CM in this trial may have been in buffering against the desensitization to suffering observed in the Familiarity condition. However, this effect was not the subject of the present investigation, so strong conclusions cannot be drawn. Future investigations geared toward this question may have important implications for nurses and other caretakers at risk of professional burnout. Indeed, interventions that enhance compassion have a wide and important range of societal applications. Better understanding the mechanisms of CM, as we sought to do here, will be critical for materializing its many potential benefits.

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