Past Adversity Protects Against the Numeracy Bias in Compassion

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Abstract

Past research has suggested that one problematic limitation of compassion is its seeming resistance to increase in response to growing numbers of targets in distress. This insensitivity to numeracy results in the dampening of compassion when faced with mass suffering. Given that emerging evidence suggests that facing past adversity in life may foster compassion and a general prosocial orientation, we explored whether those who have experienced greater adversity show a resistance to this numeracy bias. In a series of four experiments, we demonstrate not only that those who have experienced greater adversity readily overcome the numeracy bias in compassion, but also that beliefs regarding their ability to be efficacious in helping others underlie this link. Of import, we also show that direct manipulation of such efficacy beliefs can remove the numeracy bias in compassion typically found among those who have not endured significant life adversity. Finally, we explore the ability of adversity to engender prosocial donations to those in need via mechanisms involving compassion and efficacy beliefs.

Keywords: compassion, adversity, numeracy bias, self-efficacy, prosocial behavior

Past Adversity Protects Against the Numeracy Bias in Compassion

Compassion is a powerful moral emotion capable at times of driving decisions and behaviors aimed at alleviating the suffering of others (DeSteno, 2015; Goetz, Keltner & Simon-Thomas, 2010). Unfortunately, however, its emergence in people does not always seem to be objective or logical. One example of a seeming irrationality is the fact that people's feelings of compassion do not usually increase in response to greater numbers of people in distress (for a review, see Bloom, 2016; Cameron & Payne, 2011; Sharma & Morwitz, 2016). It is, in essence, often innumerate as a response – a fact that leads people frequently to experience a disproportionate amount of compassion toward a single suffering individual relative to scores of suffering victims that are part of a larger tragedy (e.g., Slovic, 2010; Small, Loewenstein, & Slovic, 2007).

Despite this barrier to compassion, there are reasons to believe that not everyone might be limited by it and remain a bystander in the face of larger-scale suffering of others they do not know. One recent hopeful sign can be seen in the example of the Cajun Navy – a group of individuals who survived the ravages of Hurricane Katrina in Louisiana and then came to the aid of the hundreds of citizens of Houston during the flooding caused by Hurricane Harvey (Plott, 2017). These individuals experienced compassion in the face of a multitude of sufferers and acted to remediate their distress. Of import, the emotional response of the Cajun Navy isn't an aberrant one. Studies of disaster-stricken areas show that people who experience hardship often band together to form “altruistic communities” that are characterized by mutual helping and cooperation aimed at ameliorating the suffering of multiple others in need (Kaniasty & Norris, 1995). As such, it may be the that one factor capable of enhancing the compassion people feel

for others in the face of greater suffering might involve having had a previous brush with suffering themselves. That is, having successfully faced previous adversity in life might enable people to extend their compassion more readily, and, thereby, make them more resistant to the numeracy bias that typically limits compassion in the face of greater numbers in need. Indeed, our past work suggests that those who have experienced adversity show an increased tendency to be compassionate (Lim & DeSteno, 2016).

Adversity, Compassion, and Prosocial Growth

Although much research has focused on the negative sequelae of facing significant adversity in life, there is a growing body of research that attests to its potential to build resiliency as well (Seery, Holman, & Silver, 2010). While such findings are in no way meant to suggest that experiencing suffering or tragedy can be a good thing, they do suggest ways in which people might adopt strategies meant to help them rebuild their lives and strengthen their relationships following adverse events.

As noted, research examining disaster-struck communities has demonstrated that affected individuals are likely to become more cooperative. As Kaniasty and Norris (1995) documented, exposure to disasters is a primary predictor of offering social (e.g. assurance, affection, and closeness), tangible (e.g. money, and shelter), and informational (e.g. situational information, and aid-related information) support to others in need. In addition, individuals who have been involved in such post-disaster “altruistic communities” often continue to be more likely to report feelings of interpersonal connectedness, a greater sense of community, and more trusting attitudes towards other people in general (Barton, 1969; Giel, 1990). Such findings suggest that facing past adversity makes people more likely to be compassionate and to engage in prosocial

actions that strengthen the social cohesion and likelihood of reciprocal support within their communities.

Lending support to this view, Vollhardt and Staub (2011) found that people who had experienced at least one traumatic life event were more likely to participate in charitable activities (e.g. fund raising, environmental or animal rights movements) than were those who did not. Of import, they were also more likely to experience empathy and compassion, as well as engage in prosocial behavior toward outgroup members in need (i.e. victims of a tsunami event in Asia). Although the nature of the exact mechanisms that give rise to this increased proclivity to be compassionate have not been fully delineated, work suggesting that people feel able and efficacious in their abilities to manage both the emotional toll of empathizing with others in distress and the successful provision of assistance to them are likely to play central roles (Cameron & Payne, 2011; Sharma & Morwitz, 2016).

Guided by this prior work, we previously set out to examine the links between the experience of life adversity, empathy, compassion, and prosociality. We expected that people who had suffered heightened levels of adversity would evidence increases in these other-oriented emotional responses that subsequently predicted engagement in actions meant to aid others in need. Using both online and lab-based paradigms, we found that increased severity of past adversities did, in fact, predict increased empathy, here defined by greater motivation to perspective take and to express concern for the suffering of others, which subsequently mediated feelings of compassion toward people in need, and via that emotion, engagement in costly efforts to help (Lim & DeSteno, 2016). Of note, this work also demonstrated the generality of the effect of adversity. Almost all types of adversity were found to enhance compassion and helping behavior equally. That is, people were not more likely to feel compassion only toward others

who were experiencing a malady or tragedy similar to their own; they felt increased compassion for all.

As a whole, this accumulating body of evidence suggests that experiencing previous adversity enhances the tendency to experience compassion. This greater readiness for compassion raises the intriguing possibility that past adversity might also buttress individuals against the numeracy bias that limits this emotion when it is needed most: in the face of increased numbers of others in distress.

Limiting Compassion: The Numeracy Bias

As a whole, the idea that compassion does not scale in response to increasing numbers of sufferers is well known (Cameron & Payne, 2011; Slovic, 2007). However, the exact question of whether it collapses or simply remains indifferent in the face of growing numbers of people in distress remains somewhat murky. For example, much of the work showing that compassion collapses in response to greater numbers of sufferers that pioneered by Paul Slovic and colleagues often utilizes financial donations as a primary dependent variable (e.g., Slovic, 2010; Small et al., 2007). Although donations to those in need are likely partly driven by any feelings of compassion felt toward them, the two phenomena do not consistently track one another (Kogut & Ritov, 2005; Small et al., 2007; Sharma & Morwitz, 2016). That is, increased or decreased donations do not always follow the same pattern as does the intensity of compassionate feelings.

In addition, the question of whether feelings of compassion, as opposed to compassionate behavior, truly collapse is further complicated by the various types of ways affective states have been measured. For example, whereas Kogut and Ritov (2005) found that feelings of distress tracked differences in giving to single versus multiple targets, feelings of empathy did not.

Likewise, whereas Västfjäll, Slovic, Mayorga, and Peters (2014) found that positive affect attached to donations decreased with increasing numbers of victims, Cameron and Payne (2011) found that initial feelings of compassion did not decrease with growing numbers of sufferers when participants held a belief that they would be asked to assist. Rather, levels of compassion simply failed to increase. Yet what is clear from this previous work taken as a whole is that compassion appears, at a minimum, usually to be resistant to magnification in the face of growing numbers of distressed targets. It is for this reason that we, following Bloom (2016), prefer to refer to empathic concern and the associated emotion of compassion as being relatively insensitive to increases in numeracy; hence our use of the term *numeracy bias*.

One theory put forth to explain the failure of compassion to scale in the face of mass suffering is the “identifiable victim effect,” which posits that individuals are more likely to alleviate the suffering of a single discernable person as opposed to a group of anonymous others (Kogut & Ritov, 2005; Slovic, 2007; Small et al., 2007). A mechanism proffered for this effect is affective saliency. That is, observing a single identifiable sufferer may more easily evoke automatic emotional responses than would a group of sufferers about whom only statistical data are presented. In essence, this theory posits that affective responses are more likely to be evoked when information is presented in a visual or story-like form (i.e., a more direct and individualized manner). In support of this view, Small and colleagues found that people donated more money to a single identifiable victim than to a group of anonymous victims even though that group, as a whole, consisted of more people in need (Small et al., 2007).

An alternative explanation for the numeracy bias, however, has been put forth by Cameron and Payne (2011), who suggest that compassion’s seeming insensitivity to numeracy may also stem from motivational and self-protective concerns as opposed to solely ones

involving decreased affective salience or ease of simulation. In a series of studies, Cameron and Payne (2011) demonstrated not only that compassion fails to increase with growing numbers of victims only when people expect that they will be called upon to assist others, but also that its diminishment is better exhibited by those more skilled in emotion regulation.

As a whole, the series of experiments conducted by Cameron and Payne (2011) supports the notion that the numeracy bias can be attributed to emotion regulatory processes. This account of the numeracy bias as a motivated choice makes good sense given the sometimes aversive and costly nature of empathy and compassion. Empathy involves the direct simulation of others' distress, an act that is itself aversive (Cameron, Hutcherson, Ferguson, Scheffers, Handjiandreou, & Inzlicht, 2019), and compassion itself, though not entirely as distressing to the experiencer, produces both elements of hedonic unpleasantness and opportunities for the expenditure of resources (Condon & Barrett, 2013; Condon & DeSteno, 2017; DeSteno 2015). Consequently, many people might prefer to avoid experiencing compassion in an effort to guard themselves against feeling emotionally overwhelmed as well as to expend valued resources that might not be effective. Indeed, recent work has clearly identified sympathizing with others as an act people perceive to be costly and, if possible, to be avoided under normal circumstances (Cameron et al., 2019).

Taken together, these findings suggest that individuals who feel better equipped to deal with and help reduce the suffering of others might not show a numeracy bias, but rather allow their compassion to scale. That is, people who, through surmounting their own past difficulties in the face of tragic situations, hold beliefs that they can readily help others through trying events might not put limits on their compassion as the number of targets for it grows. Indeed, initial evidence confirms a link between past adversity and a willingness to feel and act

compassionately (Lim & DeSteno, 2016; Staub & Vollhardt, 2008; Vollhardt & Staub, 2011). Of import, our past work also showed that a match between the types of adversity one suffered and the nature of a target's adversity played no role in the elevated compassion felt by those who had experienced trying events in their lives (Lim & DeSteno, 2016). Rather, simply the experience of knowing what it felt like to get through a time of difficult distress appeared sufficient. Therefore, we theorized that those who have experienced greater adversity in life would show an ability to overcome the usual resistance of compassion to increase in response to a growing number of targets in distress.

The Present Studies

The studies presented here begin with a basic investigation of whether those who have faced past adversity in life are less susceptible to the numeracy bias in compassion. As noted above, we anticipated that people who have experienced suffering in the past would increase their levels of compassion in response to greater numbers of victims, thereby overcoming the usual limitations of compassion in such instances. To examine this hypothesis, we adapted an established paradigm developed by Cameron and Payne (2011) in which participants are exposed to either a single child or eight children in need of assistance. This range is especially applicable for the current investigation as the greatest deviations in compassion and associated behaviors toward single versus multiple targets tends to occur in the one to ten range (Slovic, 2007; Västfjäll et al., 2014). We expected to find that the experience of adversity would moderate the degree of compassion felt toward these two types of targets.

If, as we suspect, people who have suffered in the past are less susceptible to the numeracy bias, the next set of studies were meant not only to replicate the basic finding, but to begin to explore a potential explanation for a mediating mechanism. One promising candidate is

the sense of efficacy people feel to help alleviate the suffering of others. As research on human resilience has documented, a majority of people who have experienced adversity recover from it relatively unscathed (Bonanno, 2004; Bonanno & Diminich, 2012). In light of such findings, it is reasonable to assume that the majority of individuals who had experienced some type of adversity were able to overcome it and develop adaptive ways of coping with the material, social, and emotional problems it caused (Seery, Holman, & Silver, 2010).

Such successes could be expected to endow these individuals with a greater sense of efficacy both in dealing with trying situations and in helping others to likewise overcome them. Indeed, the links of feelings of efficacy to help others has been shown in normal populations (i.e., those not selected to have experienced past life adversity) to predict both greater empathy toward all (Cameron et al., 2019) and greater charitable giving to multiple beneficiaries as opposed to single ones (Sharma and Morwitz, 2016; Västfjäll, Slovic, & Mayorga, 2015). With this in mind, we planned to examine if past adversity enhances feelings of efficacy to be compassionate, and if so, whether such feelings mediate enhanced compassion toward multiple targets.

Finally, we also believed it worthwhile to investigate whether and how any ability of past adversity to enable people to overcome the numeracy bias in compassion might translate into actual prosocial behavior. Given past work (Lim & DeSteno 2016), we expected to replicate findings that those having faced adversity would exert greater resources – here defined as increased financial donations – to others in need. However, the degree to which such behaviors would be mediated by compassion and/or a sense of efficacy remained unclear given past work demonstrating the causal priority of each with respect to helping behavior. Our final study,

therefore, was designed to examine both possibilities as a function of the number of targets in need.

Study One

To examine whether people who have faced more adversity in the past are less susceptible to the numeracy bias, we utilized a quasi-experimental design, crossing the severity of experienced life adversity (low vs. high) with exposure to single versus multiple targets in distress. Following a procedure used by Cameron and Payne (2011), we presented participants with a short paragraph describing the suffering that is afflicting children in the Darfur civil war conflict and noted that the participants would be offered an opportunity to help. After reading the paragraph, we had participants view the picture(s) of one child or eight children who were suffering due to the conflict. After viewing the image(s), we had participants rate their feelings towards the children before having them report the level of severity of any past adverse life experiences.

Method

Participants. Given the absence of a pre-existing effect size estimate to allow an informed calculation of power, we decided to recruit as many participants as we could with a goal of obtaining at least 20 per condition. In order to ensure that we had truly distinct subsets of participants with respect to past life adversity, we planned to use participants from the top and bottom thirds of the life adversity distribution found in our sample. Therefore, our recruitment goal was a minimum of 120 participants (which would result in approximately 80 for use after removing the middle third), as screening of the sample could not occur until all data were collected. We ultimately recruited 122 people, which after a division into the top and bottom third, resulted in a sample of eighty-two students (40 men, 42 women; mean age = 18.73, range =

18 – 22, $SD = 1.07$). Note that information on relevant variables for the full sample are presented in the Supplemental Materials.

Procedure. Data collection occurred in a lab equipped with individual cubicles containing desktop computers. Upon participants' arrival, the experimenter collected informed consent before proceeding with a detailed briefing regarding instructions. During the briefing, participants were led to believe that the study concerned how feelings and attitudes could affect the perception of current world events. Following a paradigm used by Cameron and Payne (2011), participants were then randomly assigned via their computer to see and read about one or eight suffering children who were affected by the civil war in the West Darfur region of Sudan. Prior to presentation of information about and images of the child (or children), participants were informed via that they would be asked to report their willingness to make a monetary donation to help the depicted individual(s). Next, they were presented with the following paragraph:

“In the West Darfur region of Sudan, there has been a civil war raging for the past five years. The Sudanese government and allied militias have been in intense conflict with various rebel groups. This conflict has resulted in unchecked violence against civilians, who have been killed, abducted, or driven from their homes. These civilians suffer from malnutrition, unsanitary living conditions, and are at risk for a variety of deadly diseases such as malaria, dysentery, and cholera. Here is a picture of one child [eight children] from Darfur.”

Immediately after the paragraph was presented, the image of one child would be displayed on the screen for participants assigned to the single-victim condition and images of eight children would be simultaneously displayed for participants assigned to the multiple-victim condition. After the presentation of the images, participants were asked to rate their feelings

towards the children. Finally, participants were asked to complete a measure of experiences with traumatic events that captured the severity levels of these past life events. Once these measures had been completed, the participants were debriefed and dismissed from the session.

Ethics approval. All experiments reported in this manuscript had received approval by the Northeastern University Institutional Review Board to ensure adequate safety and protection of privacy for human subjects.

Measures

Compassion. Feelings of compassion toward the child[ren] were assessed utilizing a nine-item self-report measure developed by Cameron and Payne (2011) (see supplementary materials). Responses were recorded using a nine-point Likert-type scale (1 = *Not at all* to 9 = *Extremely*), and included items such as: “How sympathetic do you feel toward the child [children]”, “How compassionate do you feel toward the child [children]”, and “How important is it to you that this child [these children] whose picture(s) you saw not suffer?” The measure demonstrated excellent internal consistency in this sample (Cronbach’s $\alpha = .91$).

Adverse Life Experiences. To measure the severity level of adverse life experiences, we utilized a modified version of the Diagnostic Interview Schedule section on trauma that has been employed in past research in this domain (Blum, Silver, & Poulin, 2014; Lim & DeSteno, 2016; Seery et al., 2010). This measure consists of 28 items that assess adversity people have experienced in six different domains: (1) illness/injury, (2) violence/victimization, (3) bereavement, (4) relationship events, (5) socio-environmental stressors, and (6) disasters. Within each domain, participants were asked to indicate the degree to which each type of adversity affected them using the following scale: 1 = *Never*; 2 = *barely*; 3 = *a little*; 4 = *moderately*; 5 =

severely. Final adversity scores consisted of the mean across these responses.¹ See Appendix for a detailed breakdown of the types of adversity experienced by participants in all studies.

Results

To determine whether past adversity moderated the typical numeracy bias in compassion, we conducted a 2 (Adversity: High vs. Low) X 2 (Number of Victims: Single vs. Multiple) ANOVA on participants' feelings of compassion. Although the analysis revealed that there was no main effect of the number of victims, $F(1, 78) = 0.66, p = .42$, it did show a main effect for the severity of past adversity $F(1, 78) = 6.67, p = .012$. As expected, however, this main effect was entirely driven by the predicted interaction between the number of victims and severity of participants' life adversity, $F(1, 78) = 4.60, p = .035, \eta_p^2 = .06$ (see Figure 1).

Those who had experienced little adversity in life showed the typical failure of compassion to increase with the number of suffering victims $t(39) = 0.87, p = .385, d = 0.28$. However, the compassion felt by those who had experienced greater adversity increased significantly as a function of the number of victims, $t(39) = 2.28, p = .028, d = 0.71$. Indeed, when confronted with multiple victims, the compassion experienced by those higher in past adversity was significantly greater than that experienced by those lower in past adversity, $t(45) = 3.78, p < .001, d = 1.10$.

Note that although our original plan was to use the top and bottom thirds of the adversity distribution to form two distinctly different groups for the primary analyses, we also recognize that such dichotomization can, at times, obscure a different finding that might otherwise emerge. Therefore, we present regression-based analyses using the full sample that treat adversity as a continuous variable in the Supplemental Materials. Here, and again in the primary analyses of

the interaction defining attenuation of the numeracy bias in the remaining studies, analyses using the full sample mirror those using the group-based approach reported in the main text.

Discussion

These findings provide initial support for the hypothesis that people who have experienced greater levels of past adversity might show a resistance to the numeracy bias in compassion. As they make clear, such individuals increased their feelings of compassion in direct response to the number of targets they observed in distress. Participants who had not been identified as experiencing high levels of adversity showed the same pattern found by Cameron and Payne (2011) using this paradigm: lack of a change in compassion in response to a greater number of targets in distress. However, given the preliminary nature of this finding and limited observed power of .63, a replication of this finding with an appropriate level of power is warranted.

Study Two

In study one, we found promising evidence to support the hypothesis that severity of past adversity fosters compassion towards a greater number of targets. Given that we now possessed an estimate of the effect size for the predicted interaction, we decided to conduct a replication using a sample that would afford increased power. In addition, we wished to examine a favored potential mechanism that might underlie the ability of adversity to enhance compassion for multiple victims.

As noted, previous investigation of the numeracy bias suggests that participants' beliefs about their ability to help others might play a significant role in the amount of compassion they feel. For example, Sharma and Morwitz (2016) found that boosting individuals' sense of self-efficacy for helping others subsequently led them to engage in more charitable giving toward

multiple as opposed to single targets. Similarly, work by Cameron and colleagues demonstrated that increasing people's beliefs about their efficacy to recognize other's suffering caused them to engage in more compassionate responding (Cameron et al., 2019). Given such findings, we suspect that beliefs regarding one's efficacy to help others stands as a prime candidate for mediating the effects that we observed in Study 1. In other words, it may be the case that those who have suffered more severely in the past and come through the experience intact might perceive that they are more able to help others (cf. Kaniasty & Norris, 1995; Sharma and Morwitz, 2016). Accordingly, they might allow themselves to scale compassion based on the amount of suffering they perceive, rendering them less susceptible to the numeracy bias.

Method

Participants. Using the effect size of the predicted interaction obtained in Study 1, we determined via G*Power 3.1 that a sample size of 125 was required to obtain a power of 0.80 with $\alpha = .05$.² Given that our protocol again required selection of participants scoring in the top and bottom thirds of the life adversity distribution for the sample, we set 192 as the minimum number of people to be recruited. Ultimately, we were able to recruit 192 participants, which after removing the middle third of the adversity distribution, resulted in a sample of 127 (58 male 69, female; mean age = 18.86, range = 18 – 23; SD = 1.19).

Measures and Procedure

The procedure closely mirrored that used in Study 1. Participants were randomly assigned to read a paragraph about one or eight children who were suffering in the civil war conflict in Darfur after receiving the same instructions as in the prior study. These paragraphs were accompanied by either one or eight pictures of the suffering child or children. After the pictures were presented, participants feelings of compassion were measured. Next, participants

were asked to answer two questions about their perceived levels of efficacy in helping the children depicted in the presentation using the following two items: (1) “Do you think you would be effective in helping the child[children] in Darfur?”, (2) “Do you think you would make a difference in helping the child[children] in Darfur?” The internal consistency of this two-item measure was strong (Cronbach’s $\alpha = 0.85$). Finally, participants completed the life adversity measure.

Results

We again conducted a 2 (Past Adversity: High vs. Low) X 2 (Number of Victims: Single vs. Multiple) between-subjects ANOVA to examine whether the severity of past adversity moderated the usual numeracy bias in compassion. As in Study 1, this analysis revealed the absence of a main effect for the number of victims, $F(1, 123) = 3.02, p = .09$, with a significant main effect for the severity of past adversity $F(1, 123) = 7.69, p = .006$. Once again, however, this main effect was driven by the predicted interaction, whereby past adversity moderated the degree of compassion felt toward single versus multiple targets, $F(1, 123) = 9.64, p = .002$, partial $\eta_p^2 = .07$ (see Figure 2). More specifically, individuals who have experienced greater past adversity experienced greater feelings of compassion when faced with multiple suffering targets as opposed to a single suffering target $t(62) = 3.48, p = .001, d = 0.87$. On the other hand, the compassion felt by individuals who experienced lower levels of past adversity did not differ for single versus multiple suffering targets, $t(61) = 0.95, p = .344, d = 0.24$. Thus, in the case of multiple victims, those who had suffered more severe adversity in the past experienced greater compassion than did their counterparts, $t(68) = 4.482, p < .001, d = 1.07$.

We next turned to an exploration of the potential mediating role of efficacy beliefs. Using a standard mediation analysis, we were able to establish that the severity of past adversity

individuals experienced not only predicted the amount of compassion they felt toward the suffering children, $\beta = .27$, $t(125) = 3.14$, $p = .002$, but also their feelings of efficacy to help, $\beta = .18$, $t(125) = 2.05$, $p = .042$. In addition, we confirmed that beliefs about one's efficacy to help these children, the proposed mediator, itself predicted felt compassion, $\beta = .33$, $t(125) = 3.91$, $p < .001$.

To determine whether efficacy beliefs could serve as a mediating mechanism for compassion, we regressed compassion level on both efficacy beliefs and past adversity. In this model (see Figure 3A), efficacy beliefs continued to explain a significant proportion of variance in feelings of compassion, while the magnitude of the direct effect linking severity of past adversity to compassion was reduced. The significance of the indirect effect linking adversity to compassion via efficacy was confirmed using a bias-corrected confidence interval bootstrap procedure, thereby indicating partial mediation (indirect effect = .14, CI 95% .006 – .323).

However, given the nature of the primary interaction defining attenuation of the numeracy bias – one wherein compassion increased in response to multiple victims among those who had experienced adversity but remained constant among those who were relatively free of adversity – an examination of moderated mediation was warranted. That is, if efficacy partially contributed to the attenuation of the numeracy bias, we should find different patterns of its mediating potential among members of the two groups.

Using the PROCESS macro (Hayes, 2018), we found evidence for moderated mediation (index = 0.21 CI 95% 0.002 – 0.538). As shown in Figure 3B, no evidence for an indirect effect of adversity on compassion via efficacy emerged in the case of single targets, (indirect effect = -0.008, CI 95% -0.177 – 0.149). However, for multiple targets, partial mediation via efficacy was found (indirect effect = .020, CI 95% 0.023 – 0.456, see Figure 3C).

Discussion

As predicted, we again found evidence to support the hypothesis that those who have experienced greater adversity in the past increased their levels of compassion as a function of the number of victims in distress. As such, they showed a resistance to the numeracy bias. In addition, we were able to find evidence that perceived efficacy to help others partially underlies reduced susceptibility toward the numeracy bias among those who had experienced more adversity. That is, while adversity-induced differences in efficacy were not apparent toward single victims, they were toward multiple victims and played a role in the associated increased compassion that emerged there.

Study Three

Although Study 2 produced findings suggestive that a sense of efficacy for helping others might underlie the link between experiences of past adversity and compassion, this causal inference relies on what is essentially a correlational model. Inferring the true causal strength of a proposed mediator requires experimental manipulation of the proposed mechanism. Therefore, in Study 3, we experimentally manipulated efficacy beliefs in participants to determine whether such manipulations would directly influence the downstream variable of compassion.

To examine this question, we conducted an experiment in which past adversity was crossed with manipulated perceptions of efficacy prior to measuring compassion toward multiple targets. That is, we randomly assigned half of the participants to experience a brief manipulation meant to boost their perceived efficacy to help others. We focused on the multiple targets case as it was the one in which differences in compassion were evident. If increased efficacy beliefs were responsible for attenuating the numeracy bias, we expected to find that low-adversity individuals who experienced an efficacy induction (i.e. a boost to their perceived ability to help)

would show the same level of compassion toward multiple targets as would those high in adversity. Those low in adversity who did not receive the induction should show the usual deficit in compassion toward multiple targets.

Method

Participants. Based on the average effect size from studies one and two, a power analysis from G*Power indicated that 115 participants were required to replicate the effect with a power = .80 at alpha = .05. We were able to recruit 154 participants, which after removing the middle third of the adversity distribution, resulted in a final sample of 98 (25 male, 73 female; mean age = 18.57, range = 17 – 23, SD = 1.09), which corresponded to an *a priori* power of .75.

Measures and Procedure. As in the previous studies, participants completed the measures in individual cubicles containing a personal computer. During the initial briefing, participants were told that they would be participating in a study meant to examine attitudes toward current world events.

After being briefed, participants were instructed to complete the Reading the Mind in the Eye test (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001), which was described as a type of empathy test relying on emotion recognition. However, before they began this measure, they were first required to read the following as part of the instructions:

“You are about to complete a task that measures empathy. People who are high in empathy are especially good at figuring out how the people around them are feeling. This is a good skill to have—for example, research has shown that people high in empathy are more likely to succeed in the workplace and tend to have stronger personal relationships. They are also known to be good at caring for others and to be more successful in

alleviating their pain. All in all, empathy is viewed as a good/useful skill, and one that most people want to have.

You will be shown a pair of eyes with four emotion labels around it. You are to select which one of the four emotion words best describes the emotion that the eyes are showing. Please provide one best guess for each item.”

This test served as part of the efficacy induction, as it was a device for providing false feedback regarding the efficacy of skills related to helping others in distress. Half of the participants received feedback on their score indicating that they had high efficacy in empathy-related skills (i.e., in the 95% percentile). The other half did not receive any feedback.

After the efficacy manipulation, participants completed the compassion probe featuring multiple children suffering from the Darfur civil war conflict that was used in Studies 1 and 2. In addition, participants were also asked to report their perceived level of efficacy towards helping the suffering children by answering the same two efficacy-related questions that were used in Study 2. Here, these items served as a manipulation check of our efficacy manipulation. Following the measurement of compassion and efficacy, participants completed the measure of life adversity used in the previous two studies.

Results

Examination of post-induction efficacy beliefs confirmed that the manipulation was successful. A two-way ANOVA (Efficacy Induction: Control vs. Boost $\times$ Adversity: Low vs. High) showed the presence of the expected interaction, $F(1, 94) = 5.58, p = .020, \eta_p^2 = 0.06$. Among low adversity participants (i.e., those expected to have lower efficacy), the induction significantly increased perceived efficacy, $t(46) = 2.82, p = .007, d = 0.82$ (see Figure 4). Among

high adversity individuals, the induction, as expected, had no effect due to their already heightened sense of efficacy, efficacy $t(48) = 0.50$, $p = .623$, $d = 0.14$.

With respect to compassion, a two-way ANOVA (Efficacy Induction: Control vs. Boost) $\times$ Adversity: Low vs. High) revealed a main effect of adversity, $F(1, 94) = 14.53$, $p < .001$ that was qualified by the predicted interaction, $F(1, 94) = 8.90$, $p = .004$, partial $\eta^2 = .09$ (see Figure 5). In the control condition, the usual difference among those high and low in past adversity emerged with respect to the compassion they felt toward multiple targets, $t(47) = 5.47$, $p < .001$, $d = 1.55$. However, this difference was absent when efficacy was induced, $t(47) = 0.53$, $p = .600$, $d = 0.15$. That is, when the level of perceived efficacy to help others among low adversity participants was equal to that among high adversity participants, the usual difference in compassion toward these targets disappeared. Moreover, enhanced efficacy beliefs among those low in adversity produced a significant increase in compassion toward multiple targets when compared to those low in adversity who did not receive an efficacy boost, $t(46) = 3.28$, $p = .002$, $d = 0.93$.

To better determine if the manipulated changes in efficacy mediated the changes in compassion toward multiple targets, we again conducted an analysis of moderated mediation. As expected, we found that under normal conditions (i.e., where efficacy among low adversity participants had not been experimentally enhanced), perceived efficacy mediated the link between adversity and compassion (indirect effect = 0.65, CI 95% 0.252 – 1.154, see Figure 6A). However, once the link between past adversity and efficacy was severed experimentally, no mediation occurred (indirect effect = 0.15, CI 95% -0.134 – 0.445, see Figure 6B), thereby demonstrating the expected moderation of the causal pathway (index = -0.50, CI 95% -1.052 – -0.055).

Discussion

To further examine whether efficacy serves as a mediator linking past adversity to a reduced numeracy bias in compassion, we experimentally boosted the efficacy of low-adversity individuals prior to exposing them to multiple targets in distress. In doing so, we found that people low in adversity demonstrated similar levels of elevated compassion towards multiple suffering targets as did those high in adversity, who already possessed elevated efficacy beliefs. The results of this experimental manipulation of efficacy confirm that it is one causal mechanism by which those who have experienced greater past adversity in life overcome the tendency to limit compassion toward numerous targets in need compared to their low adversity peers.

As anticipated, those possessing high levels of adversity showed similar levels of compassion regardless of exposure to the efficacy manipulation. That is, given that their sense of their own efficacy was already high, the manipulation did not boost their compassion as it did for low-adversity individuals. This fact does not preclude the possibility that stronger efficacy manipulations might produce an enhancement in compassion for those who have experienced greater adversity in life, but given the already elevated sense of efficacy among these individuals, the absence of an additive effect here is to be expected.

Study Four

In the preceding three studies, we provided evidence to support the hypothesis that people who have suffered past adversity are less susceptible to the numeracy bias in compassion. In addition, we established the role that perceived efficacy in the ability to aid victims plays as a mechanism responsible for enhanced levels of compassion toward greater numbers of potential targets. In theory, compassion is an emotion that would subsequently motivate people to alleviate the suffering of others (Goetz et al., 2010). And indeed, past work has demonstrated that

increased compassion toward people in need is associated with prosocial behavior meant to alleviate their suffering (Valdesolo & DeSteno, 2011; Lim & DeSteno, 2016).

Given this perspective, we set out to examine whether and how increased compassion stemming from experiences of past adversity might alter prosocial behavior toward single versus multiple targets. Within the somewhat narrower population of people who have experienced adversity, one of two outcomes is possible. The first, given the links between compassion and helping behavior, would be that giving assistance to single versus multiple targets would follow the pattern of changes in compassion. That is, as compassion increases in response to a greater number of distressed targets among those high in past adversity, the degree of prosocial action might increase as well. Although within the case of the numeracy bias, a one-to-one tracking does not always occur (cf. Kogut & Ritov, 2005; Small et al., 2007; Sharma & Morwitz, 2016).

An alternative possibility exists, however, for those who have experienced adversity. Whereas we would expect to again replicate resistance to the numeracy bias in compassion by those who have experienced adversity, prosocial behavior may not follow this pattern. Indeed, our past work has shown that those who have experienced greater adversity in life engage in more costly helping behavior toward both single or multiple victims in need (Lim & DeSteno, 2016). This greater charitability makes it quite plausible that high adversity individuals might demonstrate increased levels of prosocial behavior across the board. This possibility is made more likely by the work of Sharma and Morwitz (2016), who in contrasting the power of efficacy and compassion on donations toward victims in need found that efficacy – the belief that one would be able to help – solely drove donation decisions. In our past work linking compassion to helping behavior, we did not measure efficacy and, accordingly, were unable to disambiguate the effects of compassion from efficacy beliefs. In Study Four, therefore, we also

sought to determine if and how differences in compassion and efficacy resulting from past adversity would shape prosocial action.

Method

Participants. Based on the average effect size from studies one and two for the predicted interaction between adversity and compassion, a power analysis using G*Power indicated that 115 participants were needed to obtain a power = .80 at $\alpha = .05$. However, because we were also investigating charitable giving in this paradigm (for which a previous effect size estimate did not exist), we decided to increase the number of participants to match the amount of funding available to us.

As a result, we were able to recruit 223 participants using Amazon's Mechanical Turk. To help ensure data quality, the recruited participants were required to have an approval rating for all submitted Human Intelligence Tasks (HITs) that was greater than or equal to a 98%, and had completed at least 1000 HITs. Access was limited to people based in the United States. Following procedures used in the other studies, we utilized the top and bottom third of the sample with regards to participants' adversity scores. Therefore, after removing the middle third and one participant for whom data was not fully recorded, we obtained a final sample of 145 participants (71 male, 74 female; mean age = 35.19, range = 22 – 76, SD = 11.78), which corresponds to a power = .87 for the predicted interaction involving compassion, and assuming a medium effect size, a power = .85 for prosocial behavior.

Measures and Procedure. To test whether adversity-driven compassion can overcome the numeracy bias and subsequently motivate charitable giving to alleviate mass suffering, we adopted a study design that was similar to study two. Before the actual study began, participants were informed that they would be asked to report their feelings toward children who are

suffering in the Darfur civil war conflict and whether they would be willing to donate a portion of their Mechanical Turk earnings to aid the children. Participants were then randomly assigned to one of two conditions. Following the procedures used in our earlier studies, participants in one condition read a paragraph about a single suffering child in the civil war conflict; those in the other condition read about eight suffering children in the same conflict. As before, we paired these paragraphs with a picture of one or eight distressed children, respectively. After the text and pictures were presented, participants' feelings of compassion were measured using the same nine-item measure that was utilized in our previous three studies (Cronbach's $\alpha = 0.97$). Upon completing the compassion measure, participants were asked to answer the same two-item measure of efficacy that was utilized in Study Two (Cronbach's $\alpha = 0.93$).

After they have completed the self-reported measures of compassion and efficacy, participants were given an opportunity to aid the suffering child (or children) by donating to the United Nations Children's Fund (UNICEF). Participants were shown the following text:

"Dear participant, as you have read earlier in this experiment, Darfur, the western region of Sudan, has been in a state of crisis. As part of an on-going practice of our lab, we organize a yearly donation drive for a charity of our choice. This year we have chosen UNICEF -- an organization that has been responsible for massive humanitarian operations in Darfur. If you wish, you may donate part of your Mechanical Turk earnings (up to \$0.75) to UNICEF. Please choose the amount you wish to donate."

Upon reading this message, participants were presented with the opportunity to donate a part of their earnings to UNICEF. They had been informed that they would receive \$1.00 for participating the study, and here told that 25 cents was reserved for them, but that they could donate part or all of the remaining 75 cents in increments of 15 cents.

Results

Following the same analytic plan as before, we conducted a 2 (Adversity: High vs. Low) X 2 (Number of Victims: Single vs. Multiple) between-subjects ANOVA to examine whether adversity moderated the compassion individuals felt toward single versus multiple victims. In this analysis, a main effect of the number of victims $F(1, 141) = 8.92, p = .003$, and a main effect of past adversity, $F(1, 141) = 46.06, p < .001$, emerged. As expected, however, these effects were qualified by the anticipated interaction between the two variables, $F(1, 141) = 8.19, p = .005, \eta_p^2 = .06$. Replicating attenuation of the numeracy bias, we found that those high in past adversity felt greater compassion for multiple suffering targets compared to a single target, $t(72) = 5.15, p < .001, d = 1.18$, while those low in past adversity showed no such difference, $t(69) = 0.76, p = .940, d = .02$ (see Figure 7). This time, however, an ordinal main effect for severity of adversity remained even in the presence of the expected interaction. Thus, while those high in adversity did upregulate their compassion in response to an increasing number of victims, they also evidenced greater compassion in the single victim condition relative to their low adversity counterparts.³

Because compassion was elevated to some degree in both conditions, we conducted a similar analysis with perceived efficacy as the dependent variable. Here, only a main effect for adversity emerged, $F(1, 141) = 19.30, p < .001, \eta_p^2 = .12$, such that efficacy was higher among those who had experienced more ($M = 5.85, SD = 2.37$) rather than less ($M = 4.21, SD = 2.01$) severe adversity in life. As one might then expect, efficacy significantly correlated with increased compassion in both the single ($r = .58, p < .001$) and multiple ($r = .56, p < .001$) victim conditions. Given this, it became clear that in this sample, where efficacy was elevated among those higher in past adversity, efficacy could not account for the attenuation of the numeracy bias

that was observed. This in no way challenges the claim that those who have experienced adversity are less susceptible to the numeracy bias, but only that efficacy is not the sole mechanism by which changes in the bias occur – a fact made clear in the previous studies where only partial moderated mediation was observed.

Turning to charitable donations, a similar between-subjects ANOVA revealed a main effect of adversity such that people who had faced more difficulties in life generally allocated more money to help others irrespective of the number of victims, $F(1, 141) = 10.30, p = .002, \eta_p^2 = .07$ (see Figure 8). This finding is consistent with our previous research examining adversity's effects on donations (Lim & DeSteno, 2016). No evidence of a main effect, $F(1, 141) = 1.12, p = .280$, or interaction, $F(1, 141) = .02, p = .899$, involving the number of victims emerged.

To examine the proposed interrelations among the variables, we applied the covariance structure model depicted in Figure 9 to the data, which provided an acceptable fit, $\chi^2(1, N = 145) = 1.71, p = .191, RMSEA = .070$.⁴ Initial consideration of the bivariate correlations confirmed that, as expected, increased adversity was associated with increased compassion, $r(143) = .49, p < .001$, increased efficacy, $r(143) = .35, p < .001$, and increased charitable giving $r(143) = .27, p = .001$. Greater efficacy was associated with greater compassion, $r(143) = .58, p < .001$, and mediated the relationship between adversity and compassion, $\beta = .16, 95\% CI [.08, .27]$.

Compassion itself also covaried with predicted charitable giving $r(143) = .32, p < .001$.

However, when considered in context of the full structural equation model, it became clear that while efficacy influenced charitable donations, compassion, as distinct from its link with efficacy, did not. Rather efficacy mediated the effect of adversity on donations (indirect effect = 0.14, 95% *CI* .07, .24).

Discussion

The findings here again confirm both the ability of past adversity to buttress people against the numeracy bias in compassion and the central role perceptions of efficacy play mediating the effects that past adversity has on compassion. However, although adversity did enhance compassion, compassion itself did not directly influence charitable donations meant to assist children in need once efficacy beliefs were considered. While their compassion levels varied in response to the number of people suffering, those higher in adversity tended to donate more across the board as a function of their enhanced expectations that they could indeed make a difference.

In a sense, the results here mirror the findings of previous work showing past adversity leads to a general increase in prosocial behavior (Lim & DeSteno, 2016). In those studies, however, compassion mediated efforts to assist, but since efficacy was not assessed, its effects could not be disambiguated from the associated state of compassion. These findings are supported, however, by other research showing that with respect to small donations of money, efficacy beliefs, as opposed to feelings of compassion, function as a primary mediator (Sharma & Morwitz, 2016). It is important to note, though, that as the cost of offering assistance increases (e.g., offering one's time or financial assistance of a much larger value), a more direct link between compassion and prosocial action might be found. Nonetheless, what remains clear is that adversity not only allows people to overcome the numeracy bias in compassion, but also increases their efforts to aid others in need via enhanced perceptions of their likely efficaciousness.

General Discussion

The studies presented here were designed to examine whether people who have experienced past adversity in life would show resistance to the numeracy bias in compassion.

Overall, we found converging evidence supporting this view. Across studies, analyses confirmed that those who have suffered adversity in the past experienced increased compassion when faced with a greater number of targets in distress, while those who have experienced little adversity showed no change in this emotion. As such, adversity appears to allow people to overcome the typical blunted response that occurs in response to observing a greater number of targets in distress.

With respect to a mechanism for increasing compassion, we found evidence that a sense of efficacy to help plays a role. In two studies using a covariance structure modeling approach, we demonstrated that when adversity enhances people's beliefs that they would be able to assist others, it mediates greater levels of compassion. Put differently, surviving past adversity leads people to believe they will be effective in helping others, which allows them to upregulate their feelings of compassion in the face of more demanding events. Confirming the central role a sense of efficacy plays in combatting the numeracy bias, we also demonstrated that the bias could be turned on and off via a direct manipulation of efficacy beliefs. That is, when we enhanced efficacy beliefs among people lower in adversity, they showed the same level of compassion toward multiple victims as did those higher in adversity. This experimental manipulation of the proposed mediator greatly increases confidence in the causal role it is theorized to play.

In the final study, we also examined how adversity-induced efficacy and compassion impact behavior meant to aid others in distress. Although, based on compassion differences resulting from the numeracy bias, one might initially expect that more past adversity might lead people to increase donations when multiple victims were presented (as compared to when a single victim was presented), we instead found a general pattern in which those who experienced

adversity donated more in both conditions. That is, people who experienced more severe adversity behaved more prosocially irrespective of whether the target was a single victim or multiple victims. Given past research linking adversity to greater behavior meant to aid single or multiple others in distress (Lim & DeSteno, 2016), this finding seems quite plausible, especially when the degree/cost of effort given is constrained to be relatively low as it was here.

Of note, we also found that efficacy beliefs, as opposed to compassion, mediated donations (cf. Sharma & Morwitz, 2016). While this finding makes sense in many ways – people are more likely to accept costs when they believe their efforts will be successful – we believe it is premature to assume that compassion might not play a role in guiding prosocial behavior in some situations. Past work has indeed repeatedly linked compassion to costly and time-consuming actions meant to aid people (DeSteno, 2015; Valdesolo & DeSteno, 2011). It is quite possible that the increased compassion that comes with adversity may mediate more costly or effortful helping behaviors than those available here in combination with efficacy. That is, we suspect that under conditions where the immediate costs of a prosocial act are high, socially-oriented emotions like compassion might play a more prominent role in motivating seemingly selfless behaviors (DeSteno, 2009; DeSteno, Condon, & Dickens, 2016). This possibility, of course, remains an open question that future research will need to examine through a process of varying the degree of outlay required to assist others in need.

Taken together, then, the findings presented here extend previous work in two important ways. First, they provide additional evidence suggesting that post-adversity growth in the form of compassion is robust and can generalize to a context where experiencing compassion is known to be challenging (cf. Lim & DeSteno, 2016). Second, they offer support to the view that compassion, like empathy, is a choice; neither is limited by capacity or automatic biases that

cannot be overcome (cf. Cameron et al., 2019; Zaki, 2014; Zaki & Cikara, 2015). Indeed, work by Schumann, Zaki, and Dweck (2014) demonstrated how beliefs regarding the malleability of empathy – whether relevant abilities could change and grow – predicted efforts to be empathic and engage in related compassionate behavior.

Our identification of the role played by efficacy beliefs in fostering increased compassion toward multiple targets dovetails nicely both with these motivational accounts of choice and established findings linking self-efficacy to perseverance in the face of challenges. As Bandura's (1977, 1982) work makes clear, holding a belief that one possesses the requisite skills required to succeed in challenging situations stands as a primary predictor of whether an individual will engage in a task or withdraw from it. In the case of compassion, we see this playing out in a specific realm. Those who have come to believe they have what it takes to help many others in need will accept the challenge of feeling increased compassion in an effort to aid these others rather than down-regulate their compassion to protect themselves from failure or stress.

Beliefs in one's efficacy, of course, likely derive from many causes (e.g., a sense that one can handle feelings of negative affect, knowledge that even small contributions can make a difference to those in need). Exploring the workings and contributions of each source of efficacy, therefore, stands as a promising endeavor for future research and may point to effective strategies for the development of several interventions meant to reduce the prevalence of the numeracy bias.

In advocating this view, however, we are in no way arguing that adversity is good, or that one way to enhance compassion in society is to make more people suffer early in life. To the contrary, the whole function of compassion is to nudge people to reduce the suffering of others.

Where we believe these findings can be most relevant in a practical vein is in demonstrating the power of efficacy to combat the numeracy bias and the often irrational personal and policy decisions which it can engender (see Bloom, 2016). Rather than allowing people to develop efficacy through facing tragic events, the findings presented here suggests that other types of social learning might play a similar role. For example, people who volunteer to aid in disaster relief or to work with the terminally ill can be expected to develop a sense that their efforts make a difference to many others. In so doing, this increased sense of efficacy should lead them to become better able to face and thereby upregulate their compassion to more demanding situations.

Finally, it would also be fruitful to examine how adversity impacts resistance to the numeracy bias in the minority of individuals who do not recover well from tribulations (cf. Bonanno, 2004). Based on previous work showing a negative link between the recency, as opposed to the severity, of adversity and compassion for others (Lim & DeSteno, 2016), one might well expect that those still experiencing the inimical sequelae of adverse experiences could continue to succumb to the numeracy bias. If so, then interventions aimed at helping these individuals to regain a normal level of functioning might possess the added benefit of increasing their tendencies to reach out to others and thereby build stronger and more supportive social networks that will further sustain them.

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Notes

¹See Supplementary Materials for detailed information on the means and variances associated with the adversity distributions across studies as well as the relations between each specific type of adversity and compassion.

²Given the modest sample size used in Study 1, one might wonder if the obtained effect size for the predicted interaction was an overestimate. As Button et al. (2013) have noted, smaller sample sizes result in wider distributions of sample effect sizes around the true population effect size for any given effect. This fact can produce a problem, colloquially known as the “winner’s curse,” wherein replications of a significant finding can fail because of insufficient power (as the original effect size might substantially overestimate the true effect size), which in turn can make it more difficult to find the effect that was initially observed. As will become clear in the exact replication that is Study 2, we found an effect size that was almost identical to that found in Study 1 using a much larger sample ($\eta_p^2 = .07$ vs. $\eta_p^2 = .06$). Study 4 which also offers an exact replication of Study 1’s principal finding likewise produced an effect size of $\eta_p^2 = .06$. This degree of consistency strongly suggests that the effect size for the predicted interaction obtained in Study 1 was not an overestimate and that the resulting power calculations for the subsequent studies are accurate. Moreover, the changes in p-values (p ’s $\leq .005$) as a function of the higher-powered replications (i.e., Studies 2 and 4) from that found in Study 1 ($p = .035$) produces a p-curve that suggests evidentiary value.

³We suspect that this adversity-induced difference in compassion in the single victim condition reflects sampling variability, as it did not occur in the previous two experiments using the same protocol. Supporting this view, a meta-analytic examination of adversity-induced differences in the single victim condition across Studies 1, 2, and 4 shows only a trend for increased

compassion ($p = .10$). It is important to note, however, that Lim and DeSteno (2016) found that those high in adversity evidenced an increase in compassion toward a single-victim in distress compared to their low adversity counterparts. Thus, it is likely the case that the effect of adversity on compassion for single victims is much weaker than for multiple victims. What remains clear, nonetheless, is that the extent of the divergence in compassion among those high versus low in adversity significantly grows with the number of victims.

⁴Because the effects of efficacy were parallel in both the single and multiple victim conditions, only a single model is present here.

APPENDIX

Nature of Adversities

Below, we provide frequencies for each type of discrete category of adversity experienced by participants. Note that a majority of people have experienced more than one type of adverse experience.

Study 1: Prevalence of Adversity by Domain

Type of Adversity	At least once	Never	%
Illness and Injury	118	4	96.72
Violence and Victimization	87	35	71.31
Bereavement	110	12	90.16
Relationship	106	16	86.89
Social-environmental	58	64	47.54
Disaster	56	66	45.90

Study 2: Prevalence of Adversity by Domain

Type of Adversity	At least once	Never	%
Illness and Injury	185	7	96.35
Violence and Victimization	147	45	76.56
Bereavement	169	23	88.02
Relationship	168	24	87.50
Social-environmental	87	105	45.31
Disaster	90	102	46.88

Study 3: Prevalence of Adversity by Domain

Type of Adversity	At least once	Never	%
Illness and Injury	148	6	96.10
Violence and Victimization	102	52	66.23
Bereavement	141	13	91.56
Relationship	137	17	88.96
Social-environmental	71	83	46.10
Disaster	70	84	45.45

Study 4: Prevalence of Adversity by Domain

Type of Adversity	At least once	Never	%
Illness and Injury	192	31	86.10
Violence and Victimization	154	69	69.06
Bereavement	202	21	90.58
Relationship	184	39	82.51
Social-environmental	163	60	73.09
Disaster	124	99	55.61

Figure 1. Compassion as a function of target condition and past adversity (error bars represent 95% confidence intervals).

Figure 2. Compassion as a function of target condition and past adversity (error bars represent 95% confidence intervals).

* = $p < 0.05$, ** $p < 0.01$; *** = $p < 0.001$

Figure 3. Adversity's affect on compassion as mediated by efficacy beliefs. Zero order correlations are in parentheses.

Figure 4. Efficacy beliefs as a function of adversity and manipulation condition (error bars represent 95% confidence intervals).

Figure 5. Compassion as a function of past adversity and efficacy beliefs (error bars represent 95% confidence intervals).

* = $p < 0.05$, ** $p < 0.01$; *** = $p < 0.001$

Figure 6. Adversity's affect on compassion as mediated by efficacy beliefs. Zero order correlations are in parentheses.

Figure 7. Compassion as a function of target condition and past adversity (error bars represent 95% confidence intervals).

Figure 8. Charitable giving (amount donated to UNICEF) as a function of target condition and past adversity (error bars represent 95% confidence intervals).

Figure 9. Path model showing adversity's effects on compassion and financial donations as a function of efficacy..

Supplementary Materials

Full Samples Analyses

Although an extreme groups approach (e.g., using the top and bottom tertiles of a distribution to categorize participants) can be useful when examining a new, unresearched phenomenon, as is the case here, to help detect possible differences and aid in their general interpretation, it can also possess limitations (Preacher, Rucker, MacCallum, & Nicewander, 2005). Therefore, we also decided to conduct additional analyses for each study that examined the numeracy bias on their respective full samples, treating adversity as a continuous variable. Because this concern arose after data collection for the studies, we present it here as a post-hoc secondary analysis to support the analytic approach that was originally planned.

The means and standard deviations for the adversity distribution in each study were quite consistent: $M_1 = 3.67$, $SD_1 = 0.54$, $N = 122$; $M_2 = 3.67$, $SD_2 = 0.52$, $N = 192$; $M_4 = 3.50$, $SD_4 = 0.77$, $N = 223$. Note that Study 3 did not investigate the numeracy bias per se, but rather was designed to manipulate efficacy beliefs among those low and high in adversity to determine how such a manipulation would impact compassion toward multiple targets (i.e., the condition in which those low in adversity differ from those high in adversity in terms of compassion).

Study 1

Table S1 presents the results of a regression analysis wherein the intensity of participants' feelings of compassion were regressed upon adversity level, victim condition (i.e., single- vs. multiple), and their interaction. Note that both adversity and condition (dummy coded 0 = single, 1 = multiple) were centered at their respective means. As can clearly be seen, the expected interaction emerged, thereby validating the nature of the effect identified in the main text.

Supplementary Materials

Table S1

Multiple Regression Analysis Examining the Condition x Adversity Interaction in Study 1.

Variable	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p-value</i>	<i>95% CI (LL, UL)</i>	
Intercept	6.92	0.11	63.13	0.000	6.70	7.14
Condition	0.37	0.22	1.68	0.096	-0.07	0.80
Adversity	0.71	0.20	3.47	0.001	0.30	1.11
Condition × Adversity	0.98	0.41	2.38	0.019	0.16	1.79

Model $R^2 = .16$

Table S2 presents a Johnson-Neyman exploration of the change in slopes linking compassion for single to multiple victims across the adversity continuum. Here, the respective slopes linking compassion for single vs. multiple victims are displayed as a function of adversity level (as a deviation from its mean) with respective significance tests and 95% CI's.

Supplementary Materials

Table S2: Conditional effect of Single vs. Multiple Victims on Compassion at Different Values of the Adversity

Adversity Score	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>	95%CI (LL, UL)	
-1.38	-0.98	0.61	-1.62	0.109	-2.18	0.22
-1.25	-0.85	0.56	-1.53	0.129	-1.95	0.25
-1.11	-0.72	0.51	-1.42	0.158	-1.72	0.28
-0.98	-0.58	0.46	-1.28	0.202	-1.49	0.32
-0.84	-0.45	0.41	-1.11	0.270	-1.26	0.36
-0.70	-0.32	0.36	-0.88	0.379	-1.04	0.40
-0.57	-0.19	0.32	-0.58	0.560	-0.82	0.45
-0.43	-0.05	0.28	-0.19	0.848	-0.61	0.50
-0.30	0.08	0.25	0.31	0.754	-0.42	0.57
-0.16	0.21	0.23	0.92	0.358	-0.24	0.66
-0.03	0.34	0.22	1.56	0.120	-0.09	0.78
0.07	0.44	0.22	1.98	0.050	0.00	0.88
0.11	0.48	0.22	2.12	0.036	0.03	0.92
0.25	0.61	0.24	2.51	0.013	0.13	1.09
0.38	0.74	0.27	2.74	0.007	0.21	1.28
0.52	0.87	0.31	2.85	0.005	0.27	1.48
0.65	1.01	0.35	2.90	0.005	0.32	1.70
0.79	1.14	0.39	2.90	0.004	0.36	1.92
0.92	1.27	0.44	2.89	0.005	0.40	2.14
1.06	1.40	0.49	2.87	0.005	0.44	2.37
1.20	1.54	0.54	2.85	0.005	0.47	2.60
1.33	1.67	0.59	2.83	0.006	0.50	2.84

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Study 2

Table S3 presents the results of a regression analysis wherein the intensity of participants' feelings of compassion were again regressed upon adversity level, victim condition (i.e., single- vs. multiple), and their interaction. Note that both adversity and condition (dummy coded 0 = single, 1 = multiple) were centered at their respective means. As can clearly be seen, the expected interaction emerged, thereby validating the nature of the effect identified in the analysis in the main text.

Table S3

Multiple Regression Analysis Examining the Condition x Adversity Interaction in Study 2.

Variable	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p-value</i>	<i>95% CI (LL, UL)</i>	
Intercept	7.03	.08	83.38	.000	6.86	7.19
Condition	0.48	.17	2.83	.005	0.14	0.81
Adversity	0.60	.16	3.70	.000	0.28	0.92
Condition × Adversity	1.24	.33	3.78	.000	0.59	1.88

Model $R^2 = .17$

Table S4 presents a Johnson-Neyman exploration of the change in slopes linking compassion for single to multiple victims across the adversity continuum. Here, the respective slopes linking compassion for single vs. multiple victims are displayed as a function of adversity level (as a deviation from its mean) with respective significance tests and 95% CI's.

Supplementary Materials

Table S4: Conditional effect of Single vs. Multiple Victims on Compassion at Different Values of the Adversity

Adversity Score	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>	95%CI (LL, UL)	
-1.39	-1.24	0.48	-2.57	0.011	-2.19	-0.29
-1.26	-1.08	0.44	-2.43	0.016	-1.95	-0.20
-1.13	-0.92	0.41	-2.28	0.024	-1.72	-0.12
-1.00	-0.76	0.37	-2.08	0.039	-1.49	-0.04
-0.95	-0.69	0.35	-1.97	0.050	-1.38	0.00
-0.88	-0.61	0.33	-1.83	0.069	-1.26	0.05
-0.75	-0.45	0.30	-1.52	0.131	-1.03	0.13
-0.62	-0.29	0.26	-1.11	0.268	-0.81	0.23
-0.50	-0.13	0.23	-0.58	0.563	-0.59	0.32
-0.37	0.02	0.21	0.11	0.913	-0.38	0.43
-0.24	0.18	0.19	0.97	0.334	-0.19	0.55
-0.11	0.34	0.17	1.96	0.052	0.00	0.68
-0.11	0.34	0.17	1.97	0.050	0.00	0.68
0.01	0.49	0.17	2.93	0.004	0.16	0.83
0.14	0.65	0.18	3.72	0.000	0.31	1.00
0.27	0.81	0.19	4.24	0.000	0.43	1.19
0.40	0.97	0.21	4.53	0.000	0.55	1.39
0.52	1.12	0.24	4.66	0.000	0.65	1.60
0.65	1.28	0.27	4.70	0.000	0.74	1.82
0.78	1.44	0.31	4.70	0.000	0.84	2.04
0.91	1.60	0.34	4.67	0.000	0.92	2.27
1.03	1.75	0.38	4.63	0.000	1.01	2.50

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Study 4

Table S5 presents the results of a regression analysis wherein the intensity of participants' feelings of compassion were again regressed upon adversity level, victim condition (i.e., single- vs. multiple), and their interaction. Note that both adversity and condition (dummy coded 0 = single, 1 = multiple) were centered at their respective means. As can clearly be seen, the expected interaction emerged, thereby validating the nature of the effect identified in the analysis in the main text.

Table S5

Multiple Regression Analysis Examining the Condition x Adversity Interaction in Study 3.

Variable	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p-value</i>	<i>95% CI (LL, UL)</i>	
Intercept	6.51	0.11	58.62	0.000	6.29	6.73
Condition	0.66	0.22	2.96	0.003	0.22	1.10
Adversity	1.00	0.14	6.95	0.000	0.72	1.28
Condition × Adversity	0.71	0.29	2.48	0.014	0.15	1.28

Model $R^2 = .24$

Table S6 presents a Johnson-Neyman exploration of the change in slopes linking compassion for single to multiple victims across the adversity continuum. Here, the respective slopes linking compassion for single vs. multiple victims are displayed as a function of adversity level (as a deviation from its mean) with respective significance tests and 95% CI's.

Supplementary Materials

Table S6: Conditional effect of Single vs. Multiple Victims on Compassion at Different Values of the Adversity

Adversity Score	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>	95%CI (LL, UL)	
-1.50	-0.41	0.48	-0.85	0.399	-1.36	0.55
-1.35	-0.30	0.45	-0.68	0.499	-1.18	0.58
-1.20	-0.20	0.41	-0.48	0.634	-1.00	0.61
-1.05	-0.09	0.37	-0.24	0.814	-0.83	0.65
-0.90	0.02	0.34	0.06	0.956	-0.65	0.69
-0.75	0.13	0.31	0.41	0.683	-0.48	0.73
-0.60	0.23	0.28	0.83	0.407	-0.32	0.79
-0.45	0.34	0.26	1.33	0.186	-0.17	0.85
-0.30	0.45	0.24	1.88	0.061	-0.02	0.92
-0.27	0.46	0.24	1.97	0.050	0.00	0.93
-0.15	0.55	0.23	2.45	0.015	0.11	1.00
0.00	0.66	0.22	2.98	0.003	0.22	1.10
0.15	0.77	0.23	3.39	0.001	0.32	1.22
0.30	0.88	0.24	3.66	0.000	0.40	1.35
0.45	0.98	0.26	3.80	0.000	0.47	1.49
0.60	1.09	0.28	3.85	0.000	0.53	1.65
0.75	1.20	0.31	3.84	0.000	0.58	1.81
0.90	1.30	0.34	3.80	0.000	0.63	1.98
1.05	1.41	0.38	3.74	0.000	0.67	2.16
1.20	1.52	0.41	3.68	0.000	0.70	2.33
1.35	1.63	0.45	3.61	0.000	0.74	2.51
1.50	1.73	0.49	3.55	0.001	0.77	2.70

With respect to the distribution for donations, the mean was 21 cents, range was 0 – 75 cents, SD = 27 cents, and 71 people out of 145 donated. The distribution was right skewed.

Supplementary Materials

Associations Between Adversity Domain and Compassion

Below, we provide zero-order correlations for each type of discrete category of adversity experienced by participants and its association with compassion based on the full sample. Sample sizes for each domain are stated in the prevalence table.

Study 1

Type of Adversity	<i>r</i>	p-value	Mean	SD
Illness and Injury	.27	.003	3.76	0.70
Violence and Victimization	-.09	.385	3.20	0.87
Bereavement	.19	.048	3.80	0.90
Relationship	.27	.006	3.98	0.82
Social-environmental	.29	.027	3.17	0.88
Disaster	.28	.035	3.17	0.86

Study 2

Type of Adversity	<i>r</i>	p-value	Mean	SD
Illness and Injury	.22	.002	3.74	0.69
Violence and Victimization	-.01	.930	3.24	0.91
Bereavement	.16	.043	3.79	0.88
Relationship	.24	.002	4.00	0.81
Social-environmental	.10	.352	3.22	0.89
Disaster	.13	.217	3.16	0.83

Study 3

Type of Adversity	<i>r</i>	p-value	Mean	SD
Illness and Injury	.20	.017	3.84	0.65
Violence and Victimization	.26	.010	3.35	0.99
Bereavement	.28	.001	3.96	0.89
Relationship	.11	.197	4.09	0.75
Social-environmental	.14	.262	3.45	0.92
Disaster	.08	.497	3.38	0.87

Study 4

Type of Adversity	<i>r</i>	p-value	Mean	SD
Illness and Injury	.34	.000	3.65	0.83
Violence and Victimization	.24	.003	3.36	0.94
Bereavement	.46	.000	3.70	0.89
Relationship	.43	.000	3.56	0.87
Social-environmental	.28	.000	3.51	0.96
Disaster	.33	.000	3.46	0.90

Supplementary Materials

Compassion and Efficacy Measures

Compassion Scale (Cameron & Payne, 2011)

(1 = *Not at all* to 9 = *Extremely*)

1. How sympathetic do you feel toward the child [children]?
2. How warm do you feel toward the child [children]?
3. How compassionate do you feel toward the child [children]?
4. How touched were you by the child [children]?
5. How urgent do the needs of the child [children] in Darfur seem?
6. To what extent do you feel that it is appropriate to give money to aid the child [children]?
7. How much do you value the welfare of the child [children] whose picture(s) you saw?
8. How important is it to you that this child [these children] whose picture(s) you saw be happy?
9. How important is it to you that this child [these children] whose picture(s) you saw not suffer?

Efficacy Scale (Cameron & Payne, 2011)

(1 = *Not at all* to 9 = *Extremely*)

1. Do you think you would be effective in helping the child [children] in Darfur?
2. Do you think you would make a difference in helping the child [children] in Darfur?