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## Electromyographically Assessed Empathic Concern and Empathic Happiness Predict Increased Prosocial Behavior in Adults

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### Abstract

The relation between empathy subtypes and prosocial behavior was investigated in a sample of healthy adults. "Empathic concern" and "empathic happiness," defined as negative and positive vicarious emotion (respectively) combined with an other-oriented feeling of "goodwill" (i.e. a thought to do good to others/see others happy), were elicited in 68 adult participants who watched video clips extracted from the television show *Extreme Makeover: Home Edition*. Prosocial behavior was quantified via performance on a non-monetary altruistic decision-making task involving book selection and donation. Empathic concern and empathic happiness were measured via self-report (immediately following each video clip) and via facial electromyography recorded from corrugator (active during frowning) and zygomatic (active during smiling) facial regions. Facial electromyographic signs of (a) empathic concern (i.e. frowning) during sad video clips, and (b) empathic happiness (i.e. smiling) during happy video clips, predicted increased prosocial behavior in the form of increased goodwill-themed book selection/donation.

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Empathy can be defined as *an emotional state triggered by the formation of an internally generated replica of the emotional state of another combined with an other-oriented feeling of goodwill* (Light et al., 2009). "Goodwill" is defined as a thought to do good to others and/or a desire to see others happy. Implicit in this definition of goodwill is an underlying desire for the well-being (eudemonia) of someone else, not simply relief from suffering (i.e. the absence of suffering does not necessarily imply the presence of joy). This definition stems from the Buddhist conceptualization of "metta" in that goodwill means concern for the happiness of others. We conceptualize goodwill (a) as a precipitating emotional state and (b) as a behavioral outcome. In general, goodwill feelings may be present in a number of situations (e.g. during prayer, meditation, or other everyday activities). Goodwill behavior can be quantified via observation (e.g. by counting donations, volunteer time, etc.). We conceptualize goodwill feelings as a sort of attitude promoting prosocial behavior, such as the wishes one may hold for other human beings to be happy and free from suffering (as is

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espoused by several versions of Buddhist meditation practice, e.g. Sweet & Johnson, 1990); and goodwill behavior is one outcome of such feelings.

Hotly debated questions related to empathy include: What are the active ingredients that lead us to experience empathy? And what are the antecedents of prosocial behavior? In regard to the first question, Batson (1987, 1991, and 2007) proposed two main antecedents of empathy: (a) perceiving the target as in need and (b) adopting the target's perspective (i.e. perspective-taking). Over the last 50 years, laboratory manipulations of perspective-taking have frequently been used to evoke empathy (Davis, 1994). However, in line with the first antecedent described in (a) above, Batson has argued that another pathway to empathy (separate from perspective-taking) involves the empathizer conceptualizing the target's "value" (Batson et al., 1995; 2007). We conceptualize "value" as a tendency for an individual to carry a relatively stable (yet individually variable) mental representation of *how much* they are concerned about the happiness and/or well-being of other people. Activation of this conceptualization (when faced with the suffering or joy or another) may be an important route to empathy. Of note, our use of the term "value" differs from that of Batson and others in that we are not referring to the "likeability" of the target, but are referring to the empathizer's general trait level of concern for the happiness of others. Such as, in general, how much do you value the happiness of others? How important is it that other people experience positive emotions in their life? We expected this facet to relate to positive emotion in general, given the notion that individual happiness may increase the likelihood that a person will reflect on the happiness of others and be concerned with promoting it.

Ultimately, this "value" factor—which we more specifically refer to as "goodwill"—, prosocial behavior, and its relation to "empathic concern" (a subtype of empathy that generally refers to feelings of sympathy, compassion, and tenderness; Batson, 1987, 1991, 2007; Eisenberg et al., 2014) and "empathic happiness" (referred to as "empathic joy" by Batson (1995) or as "sympathetic joy" by Buddhists), was investigated in the present study. *Empathic happiness* is defined here as the combined ability to share in the positive emotional experience of another and experience an other-oriented feeling of goodwill.

In regard to the second question posed above, an important consideration concerns the *type* of prosocial behavior evoked. For example, do the antecedents of charitable monetary giving differ from the antecedents of volunteering one's time? Prior research (Harrison, 1995; The Center on Philanthropy at Indiana University, 2014) indicates that whereas 88% of American adults give *money* to charities, only roughly 50% of American adults volunteer their *time* to nonprofit organizations (Harrison, 1995). Specifically, American adults volunteered 15.2 billion hours of service, worth an estimated value of \$296.2 billion in 2011, versus monetary donations totaling \$217.79 billion in 2011 (National Philanthropic Trust, 2014). This suggests that non-monetary giving has a larger impact on society relative to strictly monetary giving, and thus is worthy of study. Thus, this form of giving served as the primary dependent variable in the present investigation. Overall, little research has been done to elucidate whether empathy prompted by goodwill (rather than by explicit perspective-taking) can account for variability in non-monetary giving in adulthood. The present study was carried out in order to begin to fill this gap in the literature.

## The Present Study

The psychophysiological correlates of the hypothesized constituent components of empathy (e.g. empathic concern, empathic happiness, and goodwill) were investigated, and the relationship between those constituent parts and subsequent non-monetary prosocial behavior was also investigated. *Empathic concern* and *empathic happiness* were elicited in 68 adults using video-clips extracted from the television show *Extreme Makeover: Home Edition*. The show elicits peak sadness and happiness in the first and second half, respectively. We hypothesized that viewing select video clips would elicit empathy in the form of empathic concern or empathic happiness, which in turn would possibly prompt prosocial behavior. To measure prosocial behavior, a task that called on adult participant's willingness to take the *time*, but not their money, to do something nice for someone else was utilized. Specifically, we predicted that prosocial behavior would be measurable as the number and type of books selected for children via a charitable program in our area. We predicted that highly empathic participants would select more books to donate to children, even though they were not compensated for their time. In addition, to test the hypothesis that empathic concern and empathic happiness contain elements of goodwill, we predicted that highly empathic participants would be more likely to choose books with a goodwill-theme, versus other non-goodwill themed books. Specific hypotheses are described below:

### **Hypothesis 1: Does electromyographically measured empathic concern and empathic happiness predict non-monetary prosocial behavior?**

Participants who demonstrated more empathic concern or empathic happiness while watching video clips (quantified via self-report and/or concomitant increased corrugator or zygomatic EMG facial activity, respectively) were predicted to select a greater number of goodwill-themed books (rather than science-themed or fairytale-themed books) relative to participants who did not demonstrate empathy in response to video clips. We reasoned that highly empathic participants would focus on and choose stimuli (i.e. books) that were congruent with their affective state (Pavey, Greitemeyer & Sparks, 2012; Rowe, Hirsh & Anderson, 2007; Bower, 1981; Gasper & Clore, 2002), and thus would select books with a goodwill-theme. In other words, if goodwill is a component of empathic concern and empathic happiness, then it should be observable as selection of books that have a goodwill-theme. Furthermore, we thought that greater expression of empathic happiness or empathic concern during video clip viewing would relate to subsequent positive affect during book selection. This hypothesis is based on the observation that both empathic concern and empathic happiness related to positive emotion in a sample of children (Light et al., 2009).

### **Hypothesis 2: Does positive affect characterize the goodwill response?**

It was also predicted that the specific psychophysiological correlate of goodwill (i.e. what happens psychophysiological during selection of goodwill-themed books?) would be positive affect quantifiable as increased zygomatic activity (i.e. increased smiling) *during* book selection periods. This was hypothesized because the literature suggests that prosocial behavior "feels good" (Moll et al., 2006) so we expected to see this manifest as a

relationship between increased smiling during book donation periods (particularly during the selection of goodwill-themed books).

## Study Design

The Public Goods Game, a behavioral economic decision making task, provides a unique means to measure goodwill (i.e. “value”) and prosocial behavior and their relation to empathic concern and empathic happiness in adulthood. In the typical Public Goods game, an individual is assigned to a group and has an initial allotment of money. Each person can add money to their private stock or contribute all or a part of it to a “public good.” These types of tasks have been used to investigate how individuals in society can be prompted to contribute to the maintenance of necessary institutions (e.g. public schools) when individuals may lack incentive to contribute voluntarily, e.g. by paying taxes. Interestingly, substantial individual differences emerge when people play this game (Hichri & Kirman, 2007; Hichri, 2005). This scatter in the data could be explained by any number of individual differences (Anderson et al., 1998), including individual differences in empathy. However, because of various constraints of the traditional Public Goods game, including the emphasis placed on money, the lack of evidence that performance on the task relates to/predicts actual real-world behavior (e.g. volunteer hours), and lack of ecological validity, we created a task with some, but not all, of the characteristics of a Public Goods game. For example, instead of giving participants the opportunity to spend money, participants were asked to take the time to make choices during the course of the experiment that could affect the well-being and education of *actual* children in the Madison Metropolitan School District. Essentially, the public good in our experiment was educational resources (i.e. books) for use by public school children.

The basis of this approach is drawn from previous research. Researchers define “moral behavior” or prosocial behavior as behavior that is socially responsive to the needs of others (Eisenberg, Hofer, Sulik & Liew, 2013). An individual who donates time and one who gives money have both engaged in “moral behavior.” Thus, some economic theories would predict no difference between making a monetary donation to a cause and giving time to that cause if the two resources are equivalent in value. For example, if a person believes that his or her time is worth \$50 per hour and is asked to choose between donating \$200 to a charitable organization and spending four hours of time to assist that charity, he or she should be equally likely to choose either form of giving, all else being equal. However, behavioral decision theory suggests that volunteering is psychologically different from spending the same amount of money (Kruger et al. 2004). For example, utilizing a sample of 242 undergraduate students (39% male, 46% white), Reed, Aquino & Levy (2007) demonstrated that adults do not interpret giving time versus giving money in the same way. People equate giving time as more caring, moral, socially responsible, and heartfelt (Reed, Aquino & Levy, 2007) even when money and time are experimentally manipulated to be equivalent. Furthermore, research in this area suggests that there are separable mindsets activated by the query to donate time versus money. Specifically, conception of time has been proposed to be more tied to emotional meaning, whereas conception of money is more tied to concepts of economic utility (Vohs, Mead & Goode, 2006). There is also evidence to support the idea that donating time relates to later increased prosocial behavior greater than what is generated

when a person agrees to make a monetary donation. Specifically, in a sample of 199 adults (mean age = 33, 29% male), researchers demonstrated that asking participants to donate time, versus money, related to greater *actual* levels of subsequent contribution (in the form of volunteering hours and/or making a monetary donation) (Liu & Aaker, 2008).

Another important concept that we wish to convey here is the fact that there is evidence to suggest that the link between donating time (i.e. volunteering) and experiencing positive emotions is strong. For example, although people consume tangible goods with the goal of becoming happy, or becoming happier, they rarely attain that goal through their purchasing behavior (Liu & Aaker, 2008). However, charitable giving (both spending one's time and spending one's money to benefit another) is tied to reported states of true happiness across the lifespan (Thoits & Hewitt, 2001; Harbaugh, Mayr & Burghart 2007, respectively).

## Methods

### Sample

Inclusion criteria included: English speaker/reader, age 18 or older. We collected information on the participant's race/ethnicity, age, education level, occupation, and whether the participant was a parent or not. We recruited 68 participants in total. Participants were recruited via newspaper, web, and flyer postings in metro Madison, Wisconsin. Participants were male (23) and female (45). The study was approved by the University of Wisconsin Institutional Review Board (IRB).

### Self-Report

Several self-report measures were administered to participants including the: **Positive Empathy Scale** (PES), a measure of trait empathic happiness (e.g. "It often makes me feel good to see the people around me smiling"); **Marlowe-Crowne Social Desirability Scale** (SDS) (Crowne & Marlowe, 1960), a means to assess the confound of socially-desirable answer biasing; the **Dispositional Positive Emotion Scale** (DPES, Shiota et al. 2006), a means to assess trait positive affect (Importantly, this scale includes a "compassion" subscale that measures trait tendency to be compassionate, so by including it in our analyses we were also able to control for this alternative social emotion when interpreting the data); and the Empathic Concern subscale of the **Interpersonal Reactivity Index** (IRI) (Davis, 1996), a measure of trait empathic concern. Participants also rated how familiar they were with the book or movie version of all of the books presented during the study, on a 0 (not at all familiar) to 3 (very familiar) likert scale. This measure allowed us to control for variation in book familiarity in our analyses.

The **Positive Empathy Scale** (*PES-15*) is a 15-item self-report questionnaire that was modeled after the **Interpersonal Reactivity Index** (IRI; Davis, 1996). The scale contains items created for the measurement of empathic happiness (e.g., "I easily get excited when those around me are lively and happy"). Participants rate these statements on a seven-point, likert-type scale ranging from 0 (not at all true) to 7 (extremely true). The relationship between empathic happiness and various other variables—including empathic concern—was investigated using a sample of 282 adults (separate study). Specifically, the construct of

empathic happiness was compared to pre-established constructs (e.g. the Interpersonal Reactivity Index, Davis, 1996; The Empathy Quotient, Lawrence, Shaw, Baker, Baron-Cohen & David, 2004; Snaith-Hamilton Pleasure Scale, Snaith, Hamilton, Morley, Humayan, Hargreaves & Trigwell, 1995; and the Beck Depression Inventory-II; Beck, Ward, Mendelson, Mock & Erbaugh, 1961). Inter-item reliability was high for the 15-item PES (Cronbach's  $\alpha = .92$ ). As predicted, scores on the *PES-15* correlated positively with scores on the: (1) Snaith-Hamilton Pleasure Scale (SHAPS; Snaith, Hamilton, Morley, Humayan, Hargreaves & Trigwell, 1995) (2) Empathy Quotient (EQ; Lawrence, Shaw, Baker, Baron-Cohen & David, 2004), and (3) Empathic Concern subscale of the Interpersonal Reactivity Index (IRI; Davis, 1996) (all  $p$ 's < .01).

### Intelligence test

The Kaufman Brief Intelligence Scale-Second Edition (Kaufman & Kaufman, 2004), was administered to all participants to get an estimate of overall cognitive functioning to use as a covariate in analyses. Intelligence (including verbal intelligence, fluid intelligence, and executive function) has been linked to theory of mind/empathy skill, particularly in children (e.g. Ibanez, Huepe, Gempp, Gutiérrez, Rivera-Rei, Toledo, 2013; Carlson, Moses & Breton, 2002; Carlson, Moses & Claxton, 2004), so an intelligence test was included in the present study in order to control for this potentially important variable in analyses. We were interested in looking at the effects of empathic concern and empathic happiness on prosocial behavior minus any potential effects of intelligence.

The test took approximately 20 minutes to administer. The KBIT-2 generates three scores: Verbal IQ, Non-Verbal IQ, and an overall IQ composite. Theoretically the verbal subtests measure crystallized ability and the non-verbal subtests measure fluid reasoning.

### Eliciting empathy in the laboratory

To elicit empathy, participants viewed video clips from an episode of the television show *Extreme Makeover: Home Edition*. The show begins by showing the audience why a particular family is in need of a remodeled home. Negative emotion such as sadness peaks during this portion of the episode, i.e. the first "sad" half. Later in the show, the team reveals the remodeled home to the family, who has been sent away while the construction team works. This part of the episode, i.e. the second "happy" half, generally elicits peak happiness. Thus, typically, the events in the show move a viewer from initial feelings of sadness and concern to feelings of contentment/happiness. The episode selected for use in our study depicts an African-American family living in Los Angeles whose home was ruined by a rare flood. Alice, the owner of the home, is a very giving community activist who promotes/provides services for children and the homeless in her area. The *Extreme Makeover* design team works to refurbish the family's home. We created clips from this episode that we believed would elicit *empathic concern* or *empathic happiness*. Criteria for inclusion of a video clip were based on the following: it provided essential information for understanding the story (e.g. who are the characters? What is their plight? What did the construction crew do? etc.), and it built upon the previous video, making the transition between clips as naturalistic as possible. We tried to keep as much of the original episode intact as possible to maintain the integrity of the story. Table 1 lists the order and length of

each of the video clips. In total, 18 video clips were created, two of which were neutrally toned and were used as a control. These neutral clips were embedded amongst the empathy-inducing clips. Importantly, all video clips were presented sequentially to match the original temporal unfolding of the show, and all clips were thematically related. Facial electromyography was recorded from each participant during each video clip. Also, participants made ratings of their momentary affect after each video clip played. The rating system is described next.

In order to determine the subjective degree to which each video clip evoked an empathic emotional response, participants had to rate their emotional response to each video clip right after the video clip played, via keyboard press. They rated the presence or absence of empathic concern and empathic happiness (Figure 1). The different descriptors presented in Figure 1 were analyzed as a continuous scale, with increasing value assigned as the scale goes alphabetically from “a” to “e.” From their ratings, a *task empathic concern* and a *task empathic happiness* score were derived. The scale for *task empathic concern* ranged from 0–4, and the scale for *task empathic happiness* ranged from 0–4. Note the rating scale for empathic happiness. Contentment and serenity were scored *higher* than happiness.

Participants also rated their level of “personal distress” following each video clip on a 0–4 scale, based on Batson et al. (1987). The following negative emotions were assessed after each video clip and form the basis of the average “personal distress” score: alarmed, troubled, grieved, upset, worried, disturbed, perturbed, distressed (Batson et al., 1987).

### Stimulus validation sample

In order to confirm that our video clips elicited emotion, we had 6 undergraduate students ( $M$  age = 20, 4 women, 2 men) view and rate the extracted video clips. We confirmed that videos from the first half (videos 2–8) of the episode generally elicited peak empathic concern and the second half of our video clips (videos 10–18) generally elicited peak empathic happiness, as predicted. Specifically, 100% of the validation sample reported experiencing peak empathic concern during videos 2 or 4. Similarly, 100% of the validation sample reported experiencing peak empathic happiness during videos 13 or 14. Of note, inspection of Table 1 demonstrates that there were video clips during the first half that elicited measurable amounts of empathic happiness. In order to understand why video clips 3 and 5 elicit empathic happiness, you have to consider the content of those video clips. In video 3, Alice’s good works in the community are described, including her involvement in advocating for children (e.g. via her participation in the development of daycares and after-school programming in her area) and adults (i.e. unemployment and shelters) in her community. Similarly, video clip 5 shows the remodeling team meeting the Alice Harris family for the first time, and there is considerable positive emotion expressed during this clip. Therefore, it is likely that these empathic happiness scores do reflect true empathic reactions and are not counter-empathic reactions.

### Eliciting prosocial behavior in the laboratory

We used a book donation task to quantify prosocial *behavior*. We hypothesized that if the participant had an empathic predisposition and was put in the desired state of empathic

concern or empathic happiness because they had just watched an emotionally moving video clip, they should also be more willing to select books. For our purposes, we chose children in the Madison Metropolitan School District to be the “target” of our participants’ potential prosocial behavior. We felt that making the target of our participants’ prosocial behavior different from the people depicted in the video clips was necessary/beneficial because we believe it provided the basis for a stronger test of our hypotheses. Specifically, we thought the task would be too transparent if participants were asked to do something charitable that was directly related to the show (i.e. donating money to the show, for example). Rather, by having participants select books for local children, we hoped to ultimately enhance our ability to make stronger conclusions as to the effects of empathic concern and empathic happiness on prosocial behavior. Specifically, we hypothesized that the relationship between empathic concern, empathic happiness, and prosocial behavior is so global that we could get participants to direct their prosocial behavior toward a totally separate group of people (i.e. children) than those that actually elicited their feelings of empathic concern or empathic happiness in the first place (i.e. the people in the video clips).

The Madison Metropolitan School District’s “Schools of Hope” program is designed to improve reading and math skills. Participants were provided with a description of the “Schools of Hope” program that explained its goals and its need for book donations before they watched any of the video clips. When participants were provided with the instructions for the empathy task, they learned that after viewing each video clip they had the opportunity to pick out a book, one of which (of their choosing) would actually be donated to the program, but they would not be paid for the additional time it took them to pick out books. Participants were paid a flat fee of \$20 for their participation. Specifically, the participant was told that at the end of the experiment, after they had made all of their book selections (a maximum of 36; participants were not told ahead of time how many books they could potentially cumulatively donate), they would have the opportunity to choose the one book from their set of book selections that they would most like us to donate on their behalf, and this one book was guaranteed to be ordered and donated to the program.

To create a more sensitive measure of prosocial behavior, participants had two opportunities (or only one if they rejected the first opportunity) per video clip to select a book. There were three categories of books for participants to choose from: (1) goodwill/prosocial theme, (2) science-themed, and (3) general stories/fairytales/biographies. On each donation opportunity, participants were always presented with one goodwill themed book (e.g. Have You Filled a Bucket Today: A Guide to Daily Happiness for Kids) one science themed book (e.g. The Human Body) and one general/fairytale themed book (e.g. The Princess and the Frog). That is, participants were presented with a slide that contained three book titles and a synopsis of each book, which they could take the time to read in addition to being presented with actual hard copies of the books to peruse before making their decision about which book to choose (note that we also included the Book Familiarity measure to control for participants picking books that they knew about from previous experience over new books). One trial followed each of 18 video clips. A trial consisted of up to two opportunities to select books. Therefore, participants had 36 opportunities to select books. Books were presented in a random order from trial to trial. If they chose a goodwill-themed book at their first opportunity of any particular trial, this did not preclude them from choosing a book with



a different theme on their second opportunity of the same trial or future trials. Our prediction was that the “goodwill-themed” books would be selected more often by participants who exhibited greater empathy in response to the video clips because we drew a parallel between the induction of a mental state of empathy and the selection of books that promote the cultivation of kindness, empathy, and compassion. The total number of books selected ranged from 0 to 36 (i.e. each participant had two opportunities per video clip to select books). Facial electromyography was also recorded during all book donation periods. The entire paradigm is presented in Figure 2.

Although we did not obtain independent ratings of the books used as experimental stimuli, books were meticulously chosen by the authors and were based on our own reading of the story *and* published reviews of the story. Books were included that were deemed to fall in each category if the review of the book specifically indicated the theme desired and the researcher also agreed that the book contained content that was in line with the desired theme.

### Electromyography

Facial expression was used as a physiological indicator of the components of empathy. Facial electromyography (or facial EMG) can be used in conjunction with other measurement tools to confirm the presence of a subjective experience of emotion that is similar in kind to the target. Facial EMG is a precise and sensitive method for measuring changes in facial expressions, and can be more sensitive than visual observation (Cacioppo et al., 1986). Facial EMG sensors measure facial muscle activity by detecting and amplifying the tiny electrical impulses that are generated by facial muscle fibers when they contract. This technique has been shown to be capable of measuring facial muscle activity to even *weakly* evocative emotional stimuli (Larsen, Norris & Cacioppo, 2003). Even when participants are instructed to inhibit their emotional expression, facial EMG sensors can still register the response (Cacioppo et al., 1986).

Studies involving the use of facial EMG suggest that activity of the corrugator muscle, which lowers the eyebrow and is involved in producing frowns, relates to increased negative emotion (Larsen, Norris & Cacioppo, 2003), and sustained reduced corrugator activity relates to positive affect (Schwartz, Fair, Salt, Mandel & Klerman, 1976). Activity of the zygomaticus major muscle, which controls smiling, is positively associated with positive emotional stimuli and positive mood state (Larsen, Norris & Cacioppo, 2003; Wolf, Mass, Ingenbleek, Kiefer, Naber & Wiedemann, 2005). Early research on the smile revealed that the frequency, intensity, and duration of zygomaticus major muscle activity positively predicted self-reported happiness of the smiler (Ekman, Davidson & Friesen, 1990; Cacioppo, Petty, Losch, Kim, Sook, 1986). Given EMG’s reliable ability to capture primary emotions (e.g. happiness, sadness, fear, etc.), it was a priori assumed that EMG would serve as a reliable index of *vicarious* affect as well. EMG has been used to measure empathic responding (see Harrison, Morgan & Critchley, 2010).

In the current study, electrodes were placed on the face of each participant—according to established standards (Cacioppo et al., 1986; Larsen et al., 2003)—before starting the empathy task as a means to measure corrugator supercilii (brow furrows/frowns) and

zygomaticus major activation (a measure of cheek muscle activity associated with smiling) *during* video presentation and *during* the book selection portion of the empathy task. This provided an additional index (in addition to self-report) of participants' experience of sadness or happiness at various points during the task.

EMG data were recorded using a Biopac MP150 recording system (Biopac Systems, Santa Barbara, CA). Grounding was provided via an electrode placed behind the ear. EMG amplifier gain was 1000 with 1 Hz high-pass and 500 Hz low-pass filtering. Sampling rate was 1000 Hz. Electrode impedances were less than 10,000 ohms at all sites. The MP150 recorded the EMG signal, which was then half-wave rectified and integrated with a 10ms time constant. Biopac EMG data were read into a Matlab program for hand scoring of data. Each run was divided into 1 s intervals and power spectral density (PSD) for each interval was computed using Welch's method (normalized) on 0.1s windows with 50% overlap. A threshold of  $15\mu\text{V}^2/\text{Hz}$  was used to eliminate any 1 s intervals exceeding this value.

An average EMG score for the zygomatic and corrugator site was calculated for each participant for each of the 18 video clips (which included two neutral video clips) using Matlab software and the equation:  $\log(\text{mean}(x))$ . Next, the average value of the two neutral video clips was subtracted from each average EMG score for each of the empathy-inducing video clips to obtain a "corrected" average EMG score for each participant for each of the experimental (empathy-inducing) video clips. In addition, an average EMG score was calculated for the book donation periods for each participant for each of the two sites (i.e. corrugator and zygomaticus).

The data were also analyzed using a GLM. Covariates were included as separate predictors (multivariate analysis). Utilizing the video clips that evoked the most empathic concern or empathic happiness across participants, two models were run with either EMG from peak "empathic concern" eliciting-video clips, or EMG from peak "empathic happiness" eliciting video clips included as predictors of "percentage of goodwill-themed books selected" during the first and second half of the task, respectively. Different predictors were used in each of the models because we a priori expected that variables related to empathic concern would map onto corrugator activity, whereas variables related to empathic happiness were expected to map onto zygomatic activity, given the role of each in negative and positive affect, respectively. The "percentage of goodwill-themed books selected" was modeled as having a gamma distribution, using an inverse link function to relate the mean of the dependent variable to a linear combination of IQ, empathic concern, etc. This corrects for the positive skewness of the dependent variable. Again, two models were created: one for zygomatic activity and one for corrugator activity. For the zygomatic model, FSIQ, trait positive affect (i.e. average **DPES** score, inclusive of the "compassion" subscale), Social Desirability (i.e. **Marlowe-Crowne**) and Book Familiarity were entered as covariates in the model with "percentage of goodwill-themed books selected" during the second "happy" half as the dependent variable. Trait empathic happiness (as measured by the **PES**) and average task empathic happiness (as measured via self-report following each of the 18 video clips) were also included as predictors of the outcome. Finally, zygomatic data from videos 3, 5, 13, 14, 15, 16, and 18 were included as predictors of "percentage of goodwill-themed books selected" during the second half. These particular video clips were selected because they

elicited the most self-reported empathic happiness (in the absence of strong empathic concern) across participants. Only these EMG data were included in the model because these specific video clips met our a priori criteria of evoking, on average, a moderate level of empathic happiness across the sample; defined as an average score of 2.0 (Table 1). Thus, we only included those videos that on average evoked an empathy response equal to or greater than 2.0. We were aware that placing them in the same model would essentially place each video clip in competition with each of the other video clips, and that was intended because we predicted a priori that those video clips that elicited the *most* empathic happiness, based on self-report, would also be the same video clips that would account physiologically for unique variance in the selection of goodwill-themed books.

The corrugator model included video 4 as predictor of “percentage of goodwill-themed books selected” during the first “sad” half. Video 4 was selected because it elicited the most self-reported empathic concern (in the absence of empathic happiness). Only video 4 EMG data were included in this model because it was the only video clip that met our a priori criteria of evoking, on average, a moderate level of empathic concern across the sample; defined as an average score of 2. (Table 1). FSIQ, average “personal distress” score (measured via self-report after each video clip), social desirability, book familiarity, trait empathic concern (as measured by the **IRI**) and average task empathic concern (measured via self-report after each of the 18 video clips) were also included in the corrugator model and were entered as predictors of “percentage of goodwill books selected” during the first “sad” half.

All analyses were performed with percentage of goodwill-themed books as the dependent variable because although the number of books selected ranged from 0 to 36 (each participant had two opportunities per video clip to select books), not every participant saw all 18 video clips (due to equipment malfunction), and thus did not get a chance to select 36 books. To accommodate these cases, the raw number of books was divided by the adjusted total number of books possible. This is how the “percent goodwill-themed books selected” outcome variable was created for each participant. For example, for a participant who saw only 16 video clips, their total number of goodwill books was divided by 32 instead of 36. Only eight participants had missing data.

In summary, we very carefully tried to account for several potential alternative and third variable explanations by including the above described covariates in each model. Specifically, we included a test of intelligence in order to look at the effects of empathy controlling for this variable given some reports in the literature that intelligence may relate to empathic responding. We also included a measure of personal distress (developed by Batson) in order to more cleanly differentiate empathic concern from personal distress and/or general negative affect. In addition, we included a measure of non-vicarious positive emotion (utilizing the Dispositional Positive Emotion Scale) in order to improve our ability to distinguish general positive affect from vicarious positive affect. Furthermore, this measure included a “compassion subscale,” so we also controlled for alternative social emotions such as compassion. We also included a measure of Book Familiarity to control for the potential effect of book/story knowledge on prosocial responding. Furthermore, we included social desirability as a covariate in all analyses too.

In addition, given that these video stimuli are very dynamic, we felt that averaging across all eight first-half video clips would sacrifice our ability to look at individual differences across time (though we do provide the results of this type of analysis at the end of the results section). Furthermore, as already noted, not all first-half videos elicited empathic concern versus empathic happiness. We chose to keep the temporal ordering of the videos, and thus, there are “pockets” of positive affect expressed during the first half. Therefore, averaging across all 8 clips rather than looking at each individual clip as a potential predictor of prosocial behavior, would have obscured our ability to determine which video clips were most potent. Our hypothesis rested on the idea that those video clips that elicited the *most* empathic concern or empathic happiness would relate to prosocial behavior. This is an individual differences question and requires a two-step process, namely we first show that we can elicit empathy in the first place, but the harder test is to see whether those video clips that produced the highest behavioral ratings of empathy actually relate in a meaningful way to the psychobiological data at corresponding moments. Then we used those “couplings” (i.e. those precise moments when behavioral and EMG data matched) to predict subsequent prosocial behavior. The richness of this approach relies on the use of the most emotionally powerful video clips.

## Results

Our participants had the following characteristics: 45 were women (66%), and all were age 18–63 ( $M=25.68$ ,  $SD=10.64$ ). The majority of participants were undergraduate students (51.47%). 20.59% of participants were college graduates, 17.65% were high school graduates or had obtained their GED, and 10.30% had obtained a graduate degree (e.g. masters, PhD, MD, JD, etc.). 74% of participants were white, 8.82% of participants were Asian, 8.82% of participants were African-American, 7.4% of participants were Hispanic, and 1.4% of participants were of Native American descent. Only 4 participants were parents, so no separate analyses were run.

Out of 68 participants, 88% of the sample selected at least 1 book. 8 (12%) participants did not select *any* books. Recall that participants had to select the single book they most wanted to be donated. 52% of these single books selected for donation had a goodwill theme, 40% had a general theme, and 8% had a science theme. Of the 60 participants who selected books, the average percentage of goodwill-themed books selected was 25% ( $SD=19.16$ ). On average, participants donated 8.7 ( $SD=6.78$ ) goodwill-themed books and 24.13 books in total ( $SD=14.04$ ). A total of 179 books were ultimately donated to the “Schools of Hope” program.

Full Scale IQ, Social Desirability, and Book Familiarity were all negatively skewed ( $-.921$ ,  $s.e.=.291$ ;  $-.709$ ,  $s.e.=.29$ ; and  $-2.17$ ,  $s.e.=.29$ ). “Percentage of goodwill-themed books selected” during the first “sad” half was positively skewed (.847,  $s.e.=.29$ ). “Percentage of goodwill-themed books selected” during the second “happy” half was also positively skewed (.616,  $s.e.=.29$ ).

Average empathy scores per video clip are listed in Table 1. The correlations between trait and task measures of empathy are listed in Table 2. There was not strong correspondence

between the trait and daily (task) versions of the empathy measures, but the correlations were in the expected (positive) direction and were modest. Overall, these results suggest our laboratory task is not redundant with self-report.

The average DPES score was 4.97 ( $SD=.67$ ) out of 7. The mean task “personal distress” score was .21 ( $SD=.026$ ). The mean task “empathic happiness” score was 1.78 ( $SD=.079$ ). The mean task “empathic concern” score was .705 ( $SD=.086$ ).

### Does behaviorally and electromyographically measured empathy predict prosocial behavior?

Greater smiling during the second “happy” half of the empathy task predicted greater smiling during book selection ( $R^2=13\%$ ,  $p=.004$ , Figure 3A). More importantly, as it represents a stronger test of our hypothesis that goodwill *feelings* are involved in empathy, greater frowning during the first “sad” half of the empathy task also predicted greater smiling during book selection ( $R^2=8\%$ ,  $p=.02$ , Figure 3B).

The GLM model that included zygomatic activity from videos 3, 5, 13, 14, 15, 16 and 18 was significant:  $F(13, 35)=5.85$  ( $p<.001$ ). Specific results are presented in Table 3. This analysis shows that video 14 from the “happy” half of the empathy task positively and uniquely predicted “percentage of goodwill-themed books selected” during the corresponding “happy” half above and beyond all covariates and all other empathic happiness eliciting video clips (see Figure 4). Video 14 also elicited the most task “empathic happiness” on average across participants, and this particular clip shows the Harris family returning to their remodeled home for the first time. Also, average task empathic happiness score uniquely and positively predicted percentage of goodwill-themed books selected during the second “happy” half ( $p<.01$ ; Figure 5). Importantly, Book Familiarity, but not trait positive affect (i.e. average DPES score) or Full Scale IQ were significant predictors of “percentage of goodwill-themed books selected” during the second “happy” half. Thus, because task “empathic happiness” did significantly predict “percentage of goodwill-themed books selected” during the “happy” half, we can distinguish general positive affect from vicarious positive affect.

The model that included corrugator activity was also significant: Model  $F(7, 50)=3.76$  ( $p<.01$ ). The specific results are listed in Table 4. This analysis shows that greater corrugator activity during video 4 (Video 4 depicts the flood that ruined the family’s home, and shows all of the damage caused by it. This is the video clip that elicited the most “empathic concern” on average in our participants) from the “sad” half of the empathy task positively and uniquely predicted “percentage of goodwill-themed books selected” during the “sad” half (Figure 6). Importantly, Full-Scale IQ, Book Familiarity, Social Desirability and “Personal Distress” were not significant predictors of “number of goodwill-themed books selected” during the first “sad” half. Lastly, trait empathic concern (as measured by the **IRI**) uniquely and positively predicted “percentage of goodwill-themed books selected” during the “sad” half as well (Figure 7).

### Does positive affect characterize the goodwill response?

Greater zygomatic activation *during* book selection related to greater percentage of goodwill-themed books selected even with Book Familiarity and Social Desirability score entered as covariates ( $F(3, 58)=3.98$ ;  $R^2=18\%$ ,  $p<.05$ ; Figure 8). This effect was absent for science or fairytale themed books (both  $p$ 's  $>.05$ ).

**Additional Results**—We are aware of the fact that EMG measures tend to correlate substantially. Importantly, there were not any significant correlations amongst the zygomatic and corrugator EMG measures in this study, suggesting that there is not a general “facial expressivity” factor that could account for the findings (correlations ranged from  $-.01$  to  $.125$ ; all  $p$ 's *ns*). Further, by selecting only the videos that elicited the most self-reported empathy to put in the models (rather than all videos), the problem of multicorrelarity is reduced. We were specifically interested in pitting zygomatic videos against each other, and corrugator videos against each other, to determine whether the “top” video (in the case of corrugator) or videos (in the case of empathic happiness) would uniquely contribute to the dependent variable with all covariates entered in.

In further support of the robustness of EMG as a measure of empathy, the following additional EMG results were obtained when looking at corrugator activity and zygomatic activity across the first and second half of the empathy task as a whole, respectively. Greater average corrugator across the first half of the experiment (when peak empathic concern occurred)—when the people in the video displayed peak negative emotion—, related to greater percentage of goodwill-themed books selected for donation even with Book Familiarity and Social Desirability entered as covariates ( $F(3, 55)=4.56$ ;  $R^2=20\%$ ,  $p=.007$ ). Similarly, greater average zygomatic activity (smiling) during the second half of the task related to greater percentage of goodwill books selected for donation even with Book Familiarity and Social Desirability entered as covariates ( $F(3, 56)=2.97$ ;  $R^2=8\%$ ,  $p=.013$ ).

When you look at the total number of books selected (irrespective of type), rather than the total number of goodwill-themed books selected, the results of the zygomatic model demonstrate that trait positive affect as measured by the Dispositional Positive Affect Scale (DPES) is the only significant predictor (of total book selection regardless of book type). The overall model is marginally significant at  $p=.07$ . Similarly, the results of the corrugator model demonstrate that trait empathic concern predicts total books selected ( $p=.045$ ); and the overall model is significant ( $p=.03$ ). This adds to our understanding of the data in that these results suggest that there is something special about the relationship between in-the-moment vicarious affect (as measured by self-report and EMG) and selection of goodwill-themed books. Specifically, the expression of vicarious affect in one moment predicts selection of goodwill-themed books in a subsequent moment, but does not relate to the total number of books selected irrespective of book type. This strengthens our idea that there is a direct connection between the induction of empathy feelings and a mindset that is actively prosocial.

## Discussion

These are the first data to demonstrate, in adults, individual differences in the electromyographical signatures of empathy subtypes and prosocial *behavior* in response to real-world suffering and joy. This is also one of the first studies to measure the psychophysiological correlates of empathic concern and empathic happiness in the same study and in the same individuals. These data demonstrate that “empathic concern” and “empathic happiness” can be reliably measured in adults using a laboratory task. Vicarious facial expressions of positive and negative emotion during an empathy-eliciting task predicted real-world book donation. Our results also suggest that the instantiation of empathic concern and empathic happiness may occur in the absence of explicit instruction to engage in perspective-taking.

First, we demonstrated that both empathic concern and empathic happiness predicted increased positive affect during the execution of prosocial behavior (i.e. book selection). This provides empirical evidence that in adults, empathic concern and empathic happiness expressed in one moment predict the expression of subsequent positive emotion and goodwill-oriented prosocial behavior in a future moment.

Next, we demonstrated that increased empathic concern (evinced by increased corrugator activity) during the video that evoked peak task empathic concern across participants—which depicted the damage caused by a rare flood—positively related to selection of books that specifically promote kindness and prosocial behavior. Importantly, this effect was temporally linked; vicarious affect during the first “sad” half predicted goodwill-themed book selection during the corresponding first “sad” half of the empathy task. Furthermore, a trait measure of “empathic concern” (i.e. **IRI** score) also predicted “percentage of goodwill-themed books selected” during the corresponding first “sad” half. This replicates findings in the literature that suggest trait measures of empathic concern are a valid means to predict prosocial behavior.

Similarly, increased empathic happiness, evinced by self-report and increased zygomatic activity during the video that elicited peak task empathic happiness across participants—a video that showcased the family’s first opportunity to see their new home—positively related to greater selection of goodwill-themed books during the corresponding second “happy” half of the empathy task. This result suggests that people can have a vicarious response to others positive emotions, and such a response predicts participants’ willingness to act in a prosocial manner a few moments later. Again, similar to the corrugator model, this effect was temporally linked; vicarious affect during the second “happy” half predicted goodwill-themed book selection during the corresponding second “happy” half of the empathy task. Furthermore, average task empathic happiness (i.e. self-reported empathic happiness following each video clip) also related to selection of goodwill-themed books during the second “happy” half (in addition to zygomatic EMG recorded during video 4). In sum, these results suggest that a relatively brief stimulus that causes the production of vicarious emotion is temporally linked to subsequent tangible prosocial behavior in adults.

Overall, our paradigm demonstrates that exposing participants to a complex emotional stimulus—one that can invoke sadness and happiness—relates to increased prosocial behavior, as people can have a vicarious emotional reaction to a) someone else's sorrow *and* b) someone else's happiness. We already know something about the neurophysiological underpinnings of this process. Specifically, Moll et al. (2006) found that anterior prefrontal cortex activity (i.e. frontopolar prefrontal cortex) elicited during an altruistic game predicted self-reported real-life engagement in volunteer activities. This activation in frontopolar prefrontal cortex was accompanied by increased ventral striatal activity. Similarly, Mobbs et al. (2009) found that individuals demonstrated greater ventral striatal and frontopolar prefrontal cortex activity when observing someone else win a game show relative to when the participant won themselves.

Our data add to this literature by suggesting that these two empathy subtypes (i.e. empathic concern and empathic happiness) have their own psychophysiological signatures. Zygomatic activity, in the context of empathic happiness, likely relates to activation in the left frontal cortex anterior to Brodmann Area 47, bilaterally in the temporal poles in the hippocampus and amygdala, basal ganglia, cerebellum, and also in the primary sensorimotor cortex (Wild et al., 2006). Further evidence for the neuroanatomical basis of the smile can be gleaned from lesion studies; emotionally driven smiling can be compromised by lesions in the tegmental brainstem, the frontal cortex, the internal capsule and striatum, the basal ganglia, and the posterior thalamus (Wild, 2006). In contrast, slightly different circuitry is thought to be activated when negative affect is expressed via facial expression. For our purposes, corrugator activity, in the context of empathic concern, likely relates to activation in the orbitofrontal cortex-amygdala circuit (Heller, Greischar, Honor, Anderle & Davidson, 2011). Specifically, corrugator is innervated by the rostral cingulate motor cortex (M3), which projects bilaterally to the facial nucleus, synapsing on corrugator muscles. The amygdala has reciprocal connections with M3, and orbitofrontal cortex has reciprocal connections with the amygdala. In sum, our results and established data on the neuroanatomical basis of facial expression suggests that at least partially separable brain networks likely underlie facial displays consistent with the experience of empathic concern versus empathic happiness.

The results presented on empathic happiness are particularly important to the field of psychology because they shed light on an understudied, yet potentially clinically (and generally) relevant route to experience positive emotion, and promote prosocial behavior. Our findings may have implications for the treatment of various disorders (e.g. Major Depressive Disorder, Parkinson's disease, etc.) in which anhedonia (the reduced ability to experience pleasure) is a prominent symptom. Specifically, our results suggest that positive emotion is an outcome that is not limited to simple and direct cause and effect axioms (e.g. I eat something sweet and I feel happy), but rather, individuals can experience positive emotions and concomitantly behave in a prosocial manner via much more complex cognitive-emotive interactions (e.g. I feel happy because person X—who I do not even know personally—feels happy). This suggests that a variety of interventions can be developed and implemented to increase positive emotion and prosocial behavior at the individual level and in society as a whole (e.g. Sweet & Johnson, 1990), as direct self-focused stimulation does not seem to be necessary for an individual to experience positive emotion or empathy, and subsequently act in a kind manner towards others that they do not even know. Our data



provide evidence that presenting participants with an emotionally provocative stimulus relates to subsequent prosocial behavior; and empathic happiness alone may stand as a potential candidate for garnering support for public goods. However, until this can be tested in a separate study, our results suggest a potent route to garner support for public goods (e.g. public school funding) involves eliciting complex emotion that is uplifting, with a mix of negative and positive emotion.

Furthermore, the diagnostic value of the dependent variable lies in its likely relevance to participant's everyday willingness to take *time* out of their busy schedules to do something nice for someone else. Thus, we believe our results, when added to the current body of literature (Finkelstein, 2008; Benz & Meier, 2006; Liu & Aaker, 2008), provides evidence that there is a relationship between volunteering *time* and dispositional and/or situational empathy. Overall, the importance of finding a relation between empathy and selection of books (which meant the participant spent time selecting the books) has real-world implications in that the most frequently cited strategy by organizations for coping with governmental funding cuts and shrinking budgets has been greater reliance on volunteers (Weisbrod, 1988). In fact, for many organizations, the work of volunteers is vital to their success and survival (Brudney, 1990). Thus, a primary task for nonprofit and public service organizations is to motivate the participation of new and continuing volunteers. Our data suggest that eliciting empathic concern and/or empathic happiness may be sufficient to encourage such non-monetary giving.

Furthermore, the results suggest, in line with neuroimaging studies, that positive affect accompanies the prosocial response, with increased smiling relating to the selection of goodwill-themed books. Thus, prosocial behavior has its own psychophysiological signature as well. This finding supports the "warm glow" theory of prosocial behavior.

Finally, as mentioned above, our results indicate that empathy elicitors do not have to be the direct target/focus of subsequent prosocial behavior. We believe this aspect of the data suggests that the benefactors of the feelings generated in the empathizer are not tightly limited to the elicitor of the empathic feelings. This may have positive prognostic value in the real-world, as this suggests that people can be driven to act prosocially toward a person or group that was not the elicitor of empathy initially. This phenomenon is a novel discovery and has implications for how eliciting empathy may be potentially useful for increasing prosocial behavior towards a wider range of people. For example, our results suggest that we may be able to elicit empathy via presentation of the plight of an in-group member and subsequently put the empathizer in a situation where they are confronted with the plight of an out-group member and this may prime the empathizer to act in a prosocial manner more so than they would have if they were simply shown the plight of the out-group member from the start. Future work is needed to test such a hypothesis.

In conclusion, our results suggest that empathic happiness and empathic concern are additional means by which to experience positive affect, which potentially has important ramifications for individuals who struggle with low levels of positive affect. Given the relative ease with which we can habituate to positive stimulation, empathic concern and particularly empathic happiness may serve as a means to improve low positive mood.

Empathy and prosocial behaviors serve as a means to strengthen social bonds, and they have positive effects on subjective well-being (Thoits & Hewitt, 2001). Empathic happiness in particular may very well be an efficient, convenient way for multiple people to experience pleasure from the same event/experience. Given the elegant work of Kent Berridge (e.g. Kringelbach & Berridge, 2012), and the fact that currently there are relatively few known areas in the brain that enhance “liking” or consummatory positive affect, the process of empathic happiness may be one candidate by which to enhance the subjective pleasantness of positive events/experiences. Future work should focus on the neural correlates of empathic happiness and the potential therapeutic applications of this construct to treat anhedonia.

Furthermore, it will be important to investigate whether repeated exposure to the types of stimuli used in this study cause habituation over time, or whether these types of stimuli can increase prosocial behavior with a longer gap between the instantiation of vicarious affect and the request or opportunity to act prosocially. It may be that there is an asymptote, such that there is an optimal level of vicarious emotion necessary to elicit increased prosocial behavior, beyond which no additional gains in prosocial behavior are seen. However, empathic happiness may cause subjective well-being that is nearly limitless, and this prospect is worthy of further study. Along the same line, it will be interesting to further investigate the extent to which both empathic concern and empathic happiness can be taught (Schuster, 1979). For example, several researchers have argued that meditation may enhance empathy by helping the meditator adopt a particular mindset that is nonjudgmental and therefore more likely to be empathic (Schuster, 1979; Anderson, 2005). Further work is needed to examine whether a course of empathy training results in increased prosocial behavior *and* increased subjective well-being. There is some research to suggest that it does (e.g. Weng et al., 2013; Klimecki et al., 2012), but the direct link between increased empathy and increased positive affect in a sample of individuals with low positive mood has yet to be made.

Limitations of the current study include the lack of inclusion of multiple episodes of the television show *Extreme Makeover: Home Edition*. The results presented here may not generalize to another episode of the same show or other types of stimuli. Furthermore, the video clips could be construed as altruism-inducing films, priming participants for altruistic behavior. We agree that it is very likely that our participants imitated the altruistic behavior of the home builders to some extent, however, this was expected. In other words, we understood that participants would smile when they saw the home builders and the family members smile, and this may have contributed to subsequent prosocial behavior. Our main aim was to get a very tough audience (healthy adults) to actually be prosocial. The demonstration of an effect between empathic emotion (i.e. empathic concern or empathic happiness) and prosocial behavior is a strength of the study; as many attempts have been made to elicit empathy, vicarious affect, prosocial behavior, and the like in this population and it has largely been an unsuccessful endeavor.

There are several other limitations to the present study. For example, self-report scales were given prior to video clip viewing. There may have been a risk of priming prosocial behavior by asking participants to rate various aspects of their emotional reactivity. Secondly, in



work is definitely needed to investigate the likely nuanced role of social emotions (rather than primary emotions such as sadness) on subsequent behavioral responding, similar to the work already in the literature related to sadness induction and subsequent negatively biased responding.

Also, given the strong prescriptive gender stereotype of women as nurturing (Eagly & Crowley, 1986), the uneven gender distribution (1/3 male, 2/3 female) of participants limits the generalizability of the findings, as goodwill-themed books may be normative choices for a nurturing person, with a greater preponderance of women falling in this category.

Also, the stimulus we chose to use definitely favored empathic happiness, and for this reason, not many of the clips elicited measurable empathic concern. This may be seen as a limitation of the study. However, we were able to get adults to feel some measurable empathic concern. This is noteworthy for two reasons. First, as mentioned, adults are notorious for being difficult to elicit genuine empathic concern in, and second, prior attempts have mainly focused on empathy for physical pain. This is one of the first studies to show that empathic concern of an existential nature (not based on physical pain) can indeed be elicited to some degree in the laboratory, in adults. Future work is needed that focuses more on eliciting non-pain related empathic concern; this study is a first step toward this, but certainly our measure of empathic concern was not perfect.

Finally, participants' responses were likely influenced by the display of smiles and frowns on the faces of the characters depicted in the television show, which we expected given that we wanted to measure two different vicarious emotional states. However, because of this, it cannot be entirely ruled out that imitation played a role in the presented results. Importantly, however, the manner in which self-reported (trait) empathic concern and (task) empathic happiness predicted the outcome variable, the manner in which EMG data corresponded with self-reported empathic concern and empathic happiness, and given that our self-report scales of empathic concern and empathic happiness certainly called for the participant to reflect on more than just imitation, we feel reasonably confident that empathic concern and empathic happiness are truly reflected in the EMG results, and cannot be reduced to imitation.

In conclusion, our findings broaden the definition of empathy and highlight facial expressive features that correlate with empathic responding and altruistic behavior.

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## References

- Anderson DT. Empathy, psychotherapy integration, and meditation: A Buddhist contribution to the common factors movement. *Journal of Humanistic Psychology*. 2005; 45:483–502.
- Anderson SP, Goeree JK, Holt CA. A theoretical analysis of altruism and decision error in public goods games. *Journal of Public Economics*. 1998; 70:297–323.

- Batson CD, Fultz J, Schoenrade PA. Distress and empathy: Two qualitatively distinct vicarious emotions with different motivational consequences. *Journal of Personality*. 1987; 55:19–35. [PubMed: 3572705]
- Batson, CD. *The altruism question: Toward a social psychological answer*. Hillsdale, NJ: Erlbaum; 1991.
- Batson CD, Turk L, Shaw LL, Klein TR. Information function of empathic emotion: Learning that we value the other's welfare. *Journal of Personality and Social Psychology*. 1995; 68:300–313.
- Batson CD, Early S, Salvarani G. Perspective taking: Imagining how another feels versus how you would feel. *Personality and Social Psychology Bulletin*. 1997; 22:751–758.
- Batson CD, Eklund JH, Chermok VL, Hoyt JL, Ortiz BG. An additional antecedent of empathic concern: Valuing the welfare of the person in need. *Journal of Personality and Social Psychology*. 2007; 93:65–74. [PubMed: 17605589]
- Beck AT, Ward CH, Mendelson M, Mock J, Erbaugh J. An inventory for measuring depression. *Archives of General Psychiatry*. 1961; 4:53–63.
- Benz, M.; Meier, S. Working Paper. Federal Reserve Bank of Boston; 2006. Do people behave in experiments as in the field?. <http://www.bos.frb.org/economic/wp/index.htm>
- Bower GH. Mood and memory. *American Psychologist*. 1981; 36:129–148. [PubMed: 7224324]
- Brudney, JL. *Fostering volunteer programs in the public sector: Planning, initiating, and managing voluntary activities*. San Francisco: Jossey-Bass; 1990.
- Cacioppo JT, Petty JT, Losch RE, Kim ME, Sook H. Electromyographic activity over facial muscle regions can differentiate the valence and intensity of affective reactions. *Journal of Personality and Social Psychology*. 1986; 50:260–268. [PubMed: 3701577]
- Carlson SM, Moses LJ, Claxton LJ. Individual differences in executive functioning and theory of mind: An investigation of inhibitory control and planning ability. *Journal of Experimental Child Psychology*. 2004; 87:299–319. [PubMed: 15050456]
- Carlson SM, Moses LJ, Breton C. How specific is the relation between executive function and theory of mind? Contributions of inhibitory control and working memory. *Infant and Child Development*. 2002; 11:73–92.
- Carstensen LL, Isaacowitz, Charles ST. Taking time seriously: A theory of socioemotional selectivity. *American Psychologist*. 1999; 54:165–181. [PubMed: 10199217]
- Crowne DP, Marlowe D. A new scale of social desirability independent of psychopathology. *Journal of Consulting Psychology*. 1960; 24:349–354. [PubMed: 13813058]
- Davis, MH. *Empathy: A social psychological approach*. Boulder, CO: Westview Press; 1996.
- Doherty RW. The emotional contagion scale: A measure of individual differences. *Journal of Nonverbal Behavior*. 1997; 21:131–154.
- Eagly AH, Crowley M. Gender and helping behavior: A meta-analytic review of the social psychological literature. *Psychological Bulletin*. 1986; 100:283–308.
- Eisenberg N, Hofer C, Sulik MJ, Liew J. The development of prosocial moral reasoning and a prosocial orientation in young adulthood: Concurrent and longitudinal correlates. *Developmental Psychology*. 2013; 50:58–70. [PubMed: 23731289]
- Eisenberg N, Miller PA. Empathy and prosocial behavior. *Psychological Bulletin*. 1987; 101:91–119. [PubMed: 3562705]
- Ekman P, Davidson RJ, Friesen WV. The Duchenne smile: Emotional expression and brain physiology: II. *Journal of Personality and Social Psychology*. 1990; 58:342–353. [PubMed: 2319446]
- Finkelstein MA. Predictors of volunteer time: The changing contributions of motive fulfillment and role identity. *Social Behavior and Personality*. 2008; 36:1353–1364.
- Gasper K, Clore GL. Attending to the big picture: mood and global versus local processing of visual information. *Psychological Science*. 2002; 13:34–40. [PubMed: 11892776]
- Harbaugh WT, Mayr U, Burghart DR. Neural responses to taxation and voluntary giving reveal motives for charitable donations. *Science*. 2007; 316:1622–1625. [PubMed: 17569866]
- Harrison NA, Morgan R, Critchley HD. From facial mimicry to emotional empathy: a role for norepinephrine? *Social Neuroscience*. 2010; 5:393–400. [PubMed: 20486012]

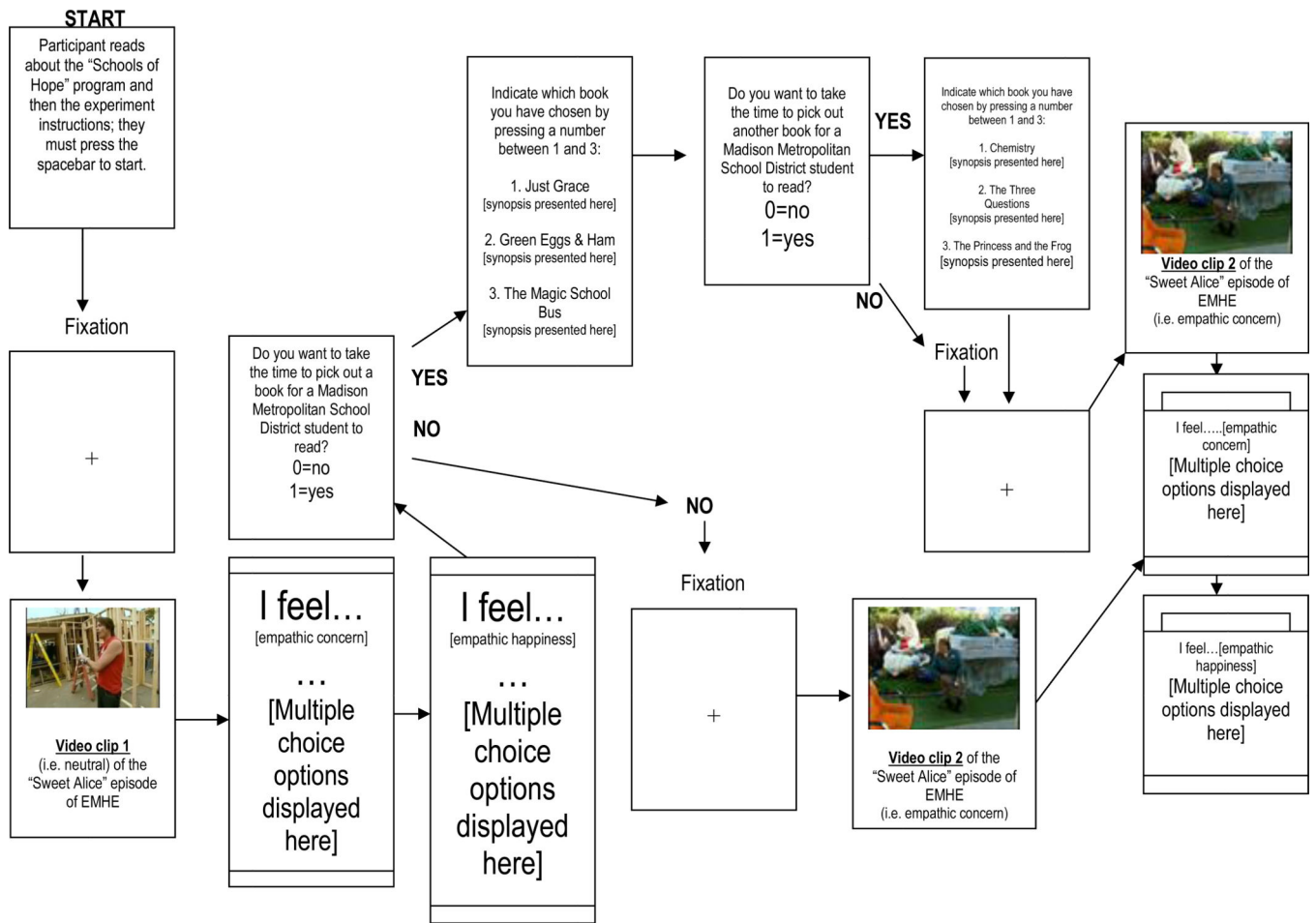
- Heller AS, Greischar LL, Honor A, Anderle MJ, Davidson RJ. Simultaneous acquisition of corrugator electromyography and functional magnetic resonance imaging: a new method for objectively measuring affect and neural activity concurrently. *N. euroimage*. 2011; 58:930–934.
- Hichri W, Kirman A. The emergence of coordination in public good games. *European Physical Journal B Condensed Matter and Complex Systems*. 2007; 55:149–159.
- Hichri W. The individual behaviour in a public goods game. *International Review on Public and Nonprofit Marketing*. 2005; 2:59–71.
- Ibanez A, Huepe D, Gempp R, Gutierrez V, Rivera-Rei A, Toledo MI. Empathy, sex and fluid intelligence as predictors of theory of mind. *Personality and Individual Differences*. 2013; 54:616–621.
- Kaufman, AS.; Kaufman, NL. Kaufman brief intelligence test second edition. Bloomington, MN: NCS Pearson, Inc; 2004.
- Klimecki OM, Leiberg S, Lamm C, Singer T. Functional neural plasticity and associated changes in positive affect after compassion training. *Cerebral Cortex*. 2012; 23:1552–1561. [PubMed: 22661409]
- Krebs D. Empathy and altruism. *Journal of Personality and Social Psychology*. 1975; 32:1134–1146. [PubMed: 1214217]
- Kringelbach ML, Berridge KC. The joyful mind. *Scientific American*. 2012 Aug.:40–45.
- Kruger J, Wirtz D, Van Boven L, Altermatt TW. The effort heuristic. *Journal of Experimental Social Psychology*. 2004; 40:91–98.
- Larsen JT, Norris CJ, Cacioppo JT. Effects of positive and negative affect on electromyographic activity over zygomaticus major and corrugator supercilii. *Psychophysiology*. 2003; 40:776–785. [PubMed: 14696731]
- Lawrence EJ, Shaw P, Baker D, Baron-Cohen S, David AS. Measuring empathy: reliability and validity of the Empathy Quotient. *Psychological Medicine*. 2004; 34:911–924. [PubMed: 15500311]
- Light SN, Coan JA, Zahn-Waxler C, Frye C, Goldsmith HH, Davidson RJ. Empathy is associated with dynamic change in prefrontal brain electrical activity during positive emotion in children. *Child Development*. 2009; 80:1210–1231. [PubMed: 19630903]
- Light SN, Heller AS, Johnstone T, Kolden G, Peterson MJ, Kalin NH, Davidson RJ. Reduced right ventrolateral prefrontal cortex activity while inhibiting positive affect is associated with improvement in hedonic capacity after 8 weeks of antidepressant treatment in major depressive disorder. *Biological Psychiatry*. 2011; 70:962–968. PMID: PMC3200460. [PubMed: 21867991]
- Light, SN.; Zahn-Waxler, C. Nature and Forms of Empathy in the First Years of Life. In: Decety, J., editor. *Empathy: from bench to bedside*. Cambridge, MA: MIT Press; 2011. p. 108-130.
- Liu W, Aaker J. The happiness of giving: The time-ask effect. *Journal of consumer Research*. 2008; 35:543–557.
- Mobbs D, Yu R, Meyer M, Passamonti L, Seymour B, Calder AJ, Schweizer S, Frith CD, Dalgleish T. A key role for similarity in vicarious reward. *Science*. 2009; 324:900. [PubMed: 19443777]
- Moll J, Krueger F, Zahn R, Pardini M, de Oliveira-Souza R, Grafman J. Human fronto-mesolimbic networks guide decisions about charitable donation. *Proceedings of the National Academy of Science USA*. 2006; 103:15623–15628.
- Pavey L, Greitemeyer T, Sparks P. “I help because I want to, not because you tell me to”: Empathy increases autonomously motivated helping. *Personality and Social Psychology Bulletin*. 2012; 38:681–689. [PubMed: 22326945]
- Reed A, Aquino K, Levy E. Moral identity and judgments of charitable behaviors. *Journal of Marketing*. 2007; 71:178–193.
- Rowe G, Hirsh JB, Anderson AK. Positive affect increases the breadth of attentional selection. *Proceedings of the National Academy of Science USA*. 2007; 104:383–388.
- Royzman EB, Rozin P. Limits of symhedonia: The differential role of prior emotional attachment in sympathy and sympathetic joy. *Emotion*. 2006; 6:82–93. [PubMed: 16637752]
- Schwartz GE, Fair PL, Salt P, Mandel MR, Klerman GL. Facial expression and imagery in depression: an electromyographic study. *Psychosomatic Medicine*. 1976; 38:337–347. [PubMed: 981492]

- Shiota MN, Keltner D, John OP. Positive emotion dispositions differentially associated with Big Five personality and attachment style. *Journal of Positive Psychology*. 2006; 1:61–71.
- Snaith RP, Hamilton M, Morley S, Humayan A, Hargreaves D, Trigwell P. A scale for the assessment of hedonic tone: The Snaith-Hamilton Pleasure Scale. *British Journal of Psychiatry*. 1995; 167:99–103. [PubMed: 7551619]
- Stotland, E. Exploratory studies in empathy. In: Berkowitz, L., editor. *Advances in experimental social psychology*. New York: Academic Press; 1969. p. 271-314.
- Sweet MJ, Johnson CG. Enhancing empathy: The interpersonal implications of a Buddhist meditation technique. *Psychotherapy*. 1990; 27:19–29.
- Thoits PA, Hewitt LN. Volunteer work and well-being. *Journal of Health and Social Behavior*. 2001; 42:115–131. [PubMed: 11467248]
- Vohs HD, Mead NL, Goode MR. The psychological consequences of money. *Science*. 2006; 314:1154–1156. [PubMed: 17110581]
- Weisbrod, BA. *The nonprofit economy*. Cambridge, MA: Harvard University Press; 1988.
- Weng HY, Fox AS, Shackman AJ, Stodola DE, Caldwell JZK, Olson MC, Rogers GM, Davidson RJ. Compassion training alters altruism and neural responses to suffering. *Psychological science*. 2013; 24:1171–1180. [PubMed: 23696200]
- Wild PB, Rodden FA, Rapp A, Erb E, Grudd W, Ruch W. Humor and smiling. *Neurology*. 2006; 66:887–893. [PubMed: 16567707]
- Wolf K, Mass R, Ingenbleek T, Kiefer F, Naber D, Wiedemann K. The facial pattern of disgust, appetite, excited joy and relaxed joy: An improved facial EMG study. *Scandinavian Journal of Psychology*. 2005; 46:403–409. [PubMed: 16179022]
- Zahn-Waxler C, Radke-Yarrow M, Wagner E, Chapman M. Development of concern for others. *Developmental Psychology*. 1992; 28:126–136.

<p>I feel:</p> <p>a) Neutral/none of these emotions</p> <p>b) Happy</p> <p>c) Contentment (i.e. a feeling of “calm happiness” such as what you may feel when you reflect on a positive memory or may have felt when you read a happy ending to a book as a child)</p> <p>d) Serene (i.e. a feeling of happiness or contentment marked by a feeling of being inspired or moved emotionally; tranquility)</p> <p>e) I feel really good because 1 or more of the people in the video feel good/ The positive mood of 1 or more of the people in the video clip has really rubbed off on me</p>	<p>I feel:</p> <p>a) Neutral/none of these emotions</p> <p>b) Sad</p> <p>c) Concerned</p> <p>d) Sad and concerned</p> <p>e) I feel really bad because 1 or more of the people in the video feel bad, are in pain, or are suffering emotionally, mentally or physically/ The negative mood of 1 or more of the people in the video clip has really rubbed off on me/ I “feel the pain” of 1 or more of the people in the video clip deeply</p>
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**Figure 1.**  
State (task) empathy rating scale.





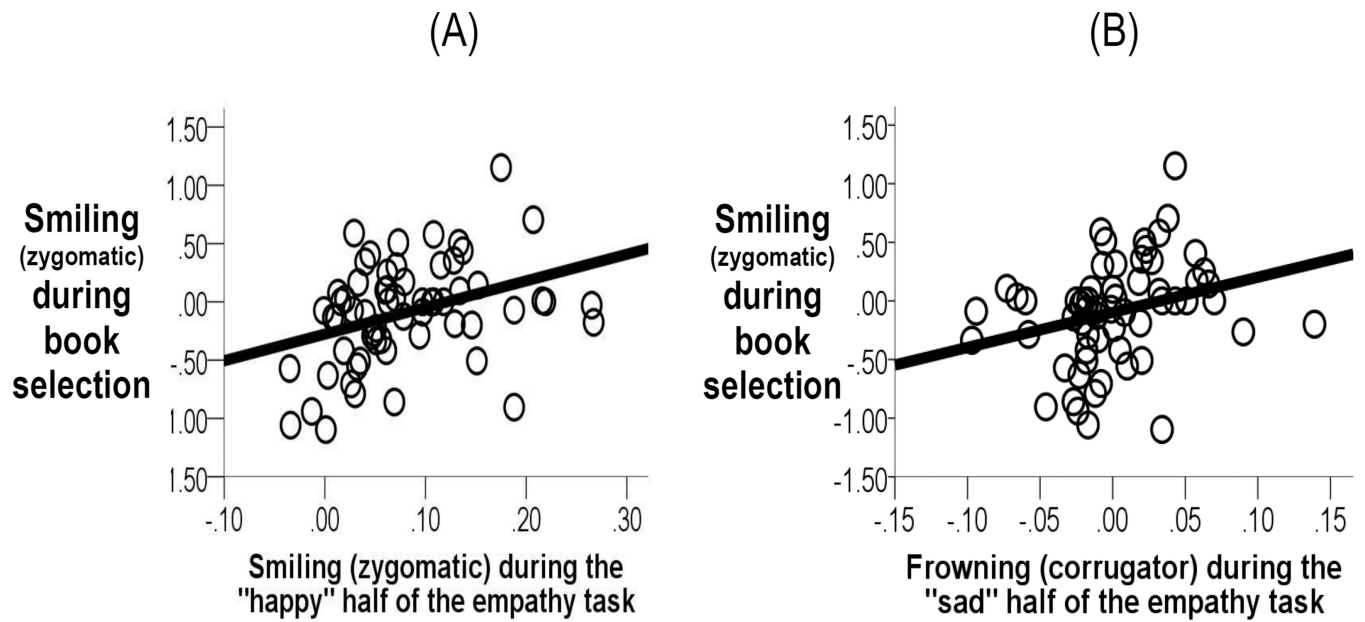
**Figure 2.**  
Empathy induction paradigm.

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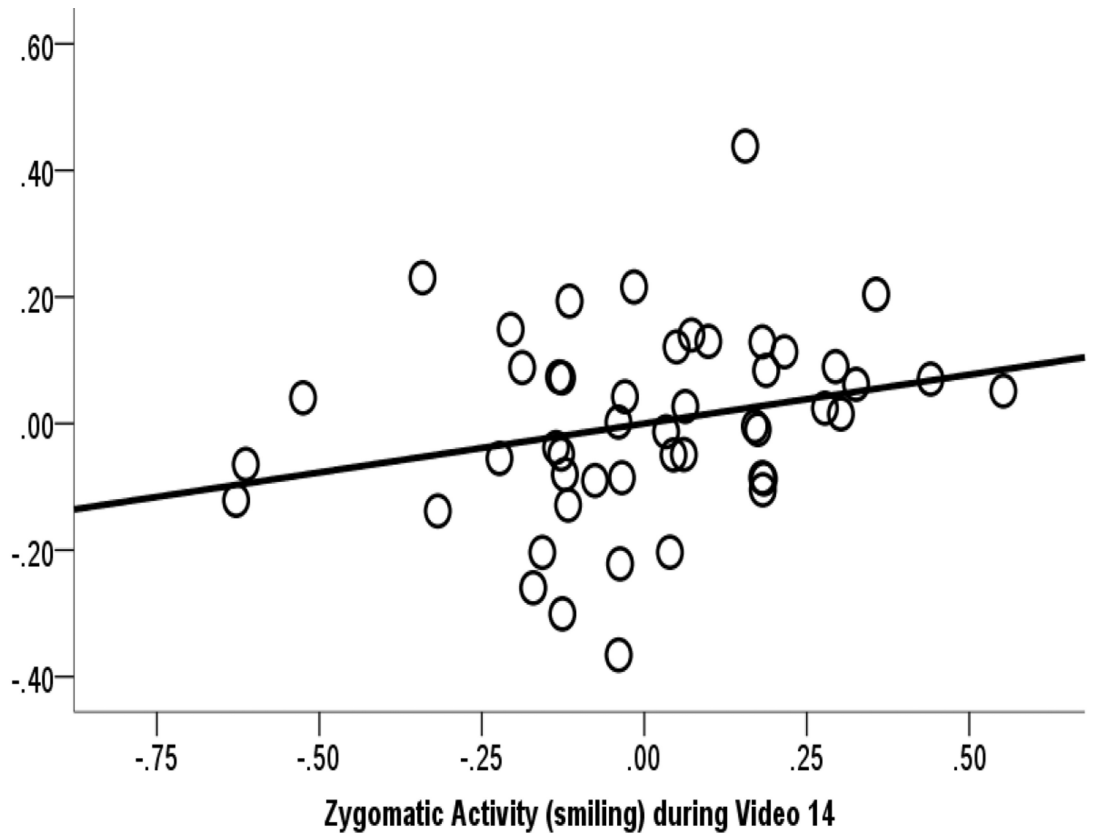
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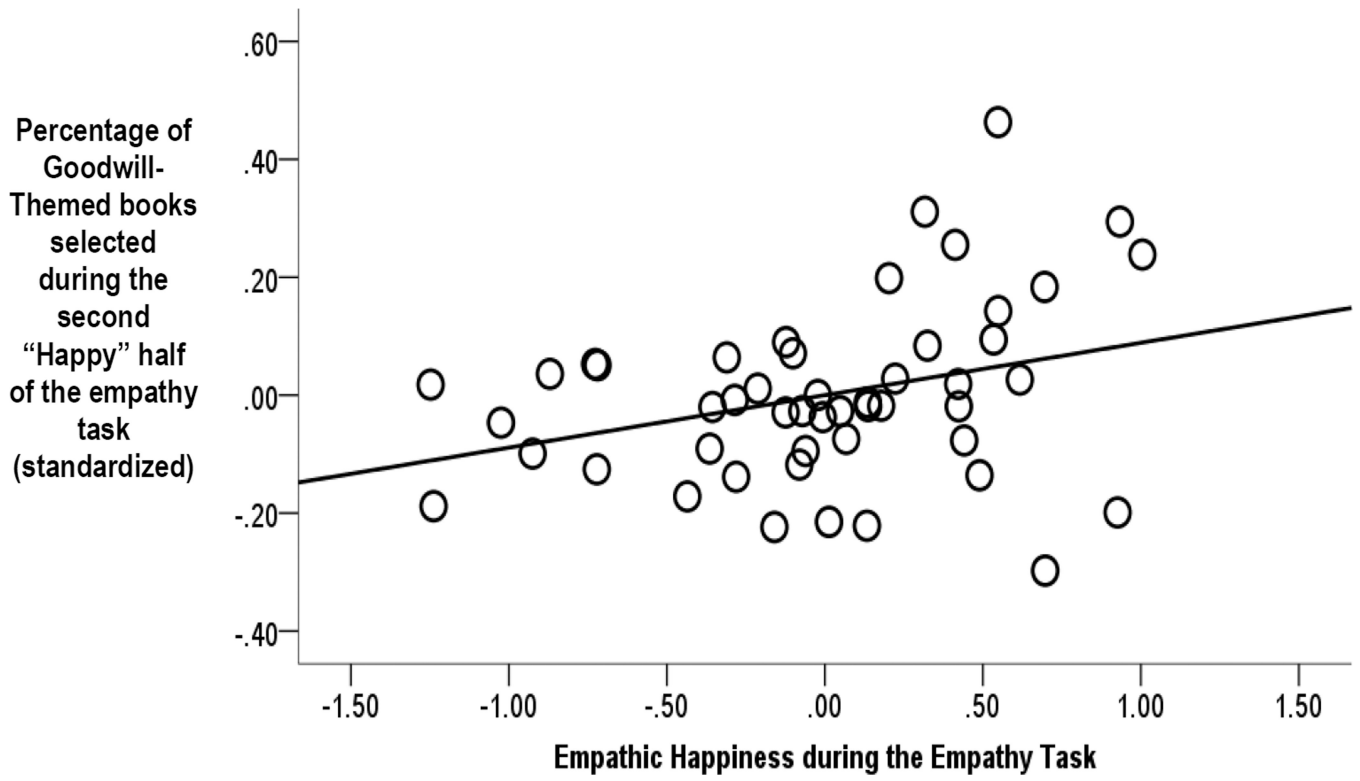
**Figure 3.**

(A) Positive vicarious emotion relates to goodwill feelings during book selection ( $R^2=13\%$ ,  $p=.004$ ); (B) Negative vicarious emotion relates to goodwill feelings during book selection ( $R^2=8\%$ ,  $p=.02$ ).

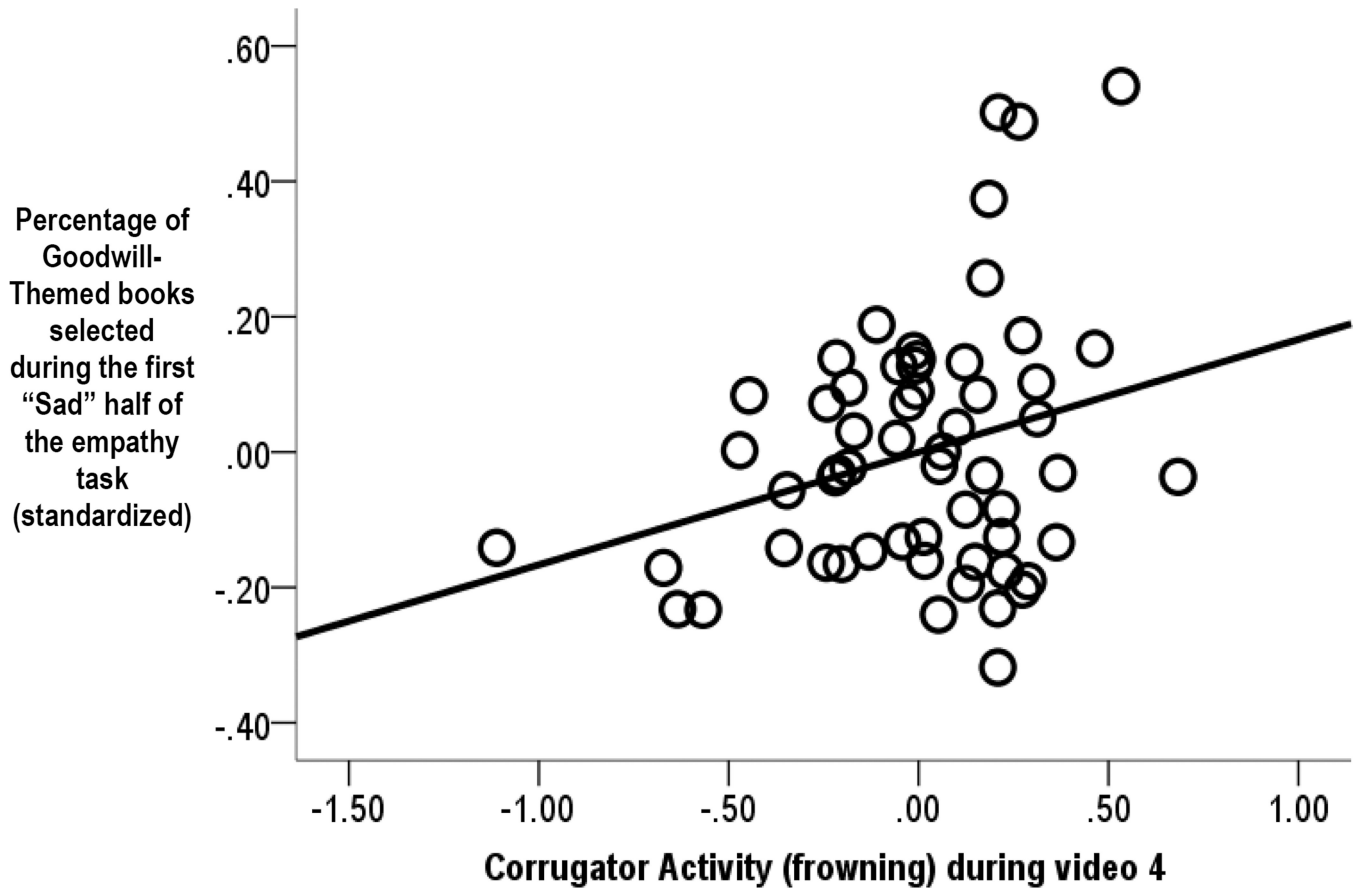
Percentage of Goodwill-Themed books selected during the second "Happy" half of the empathy task (standardized)



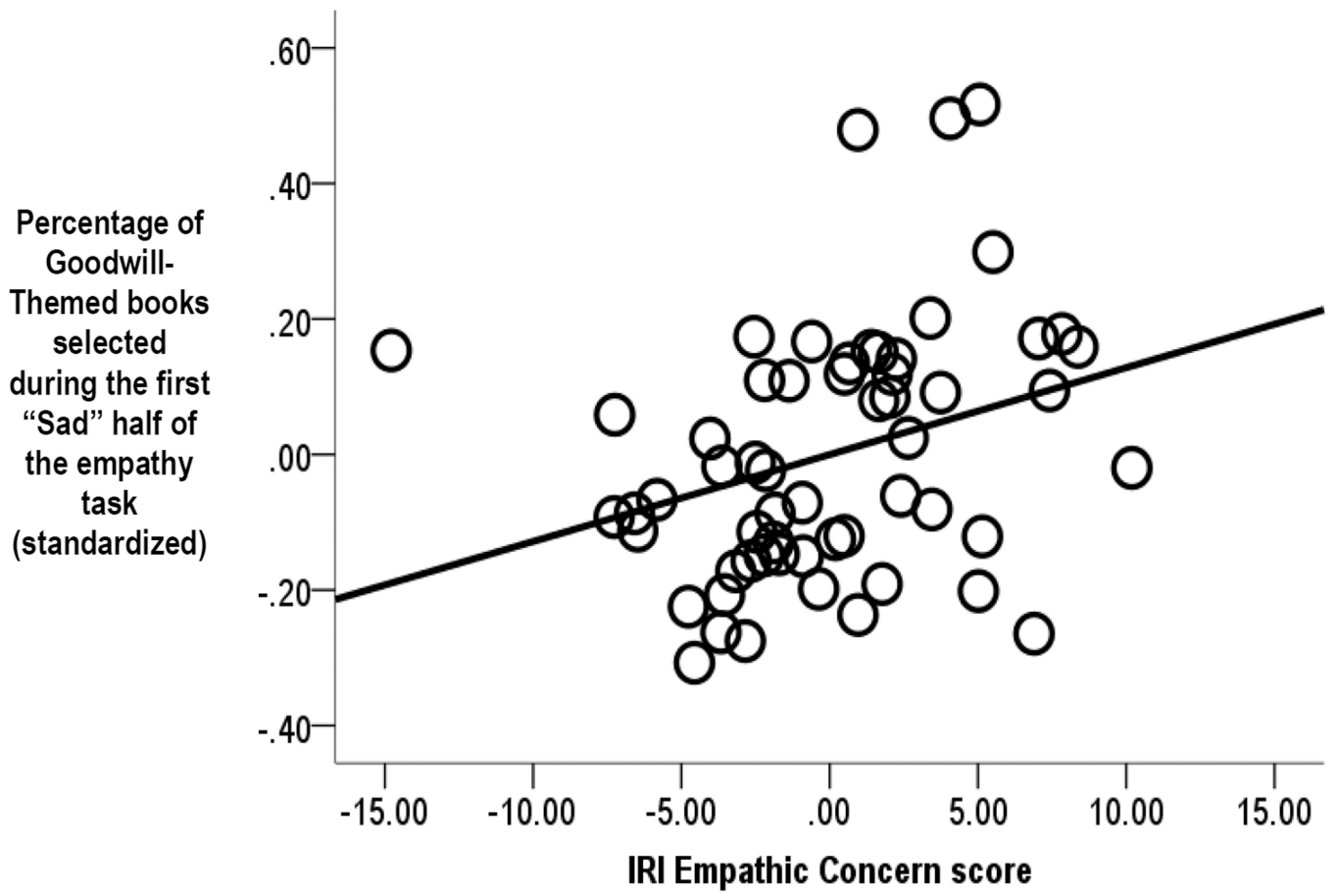
**Figure 4.** Regression plot ( $R^2=7\%$ ,  $p<.05$ ).



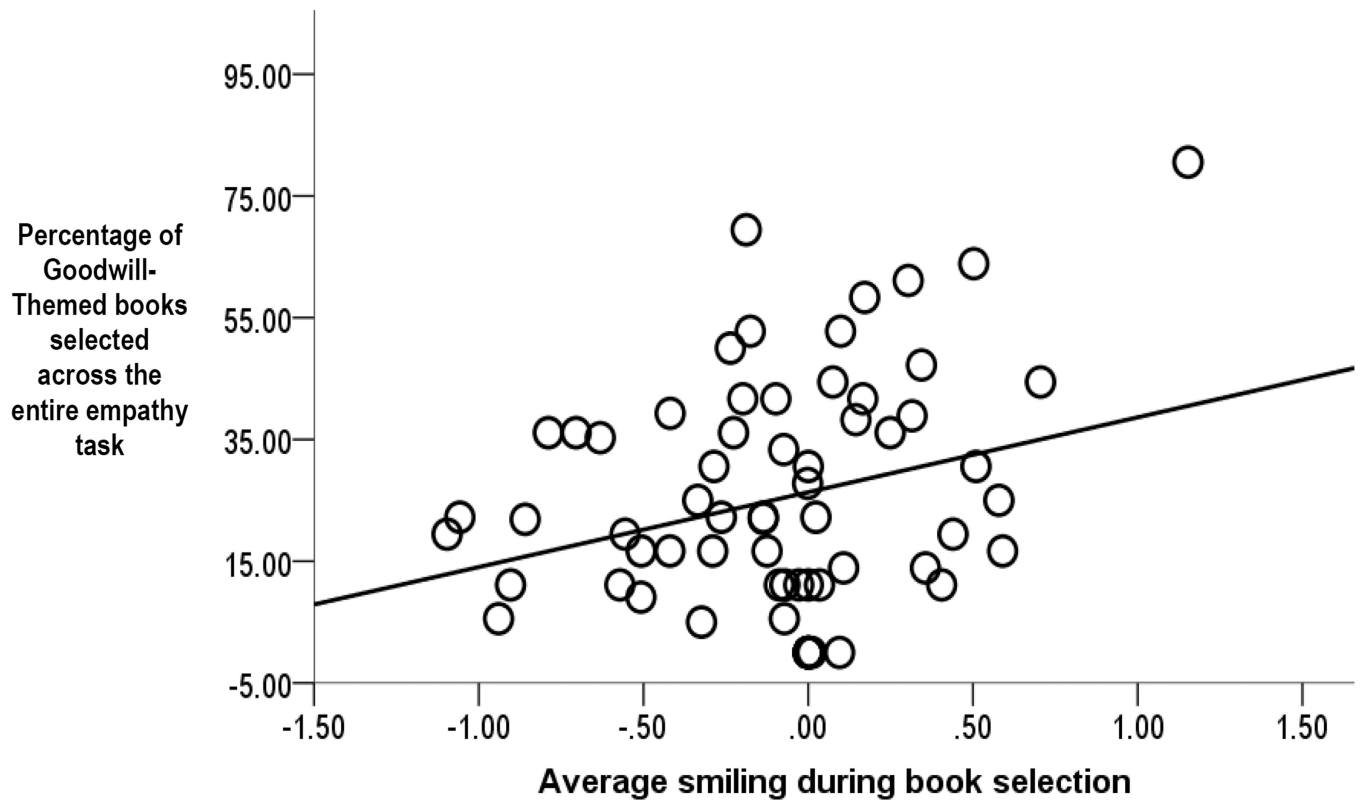
**Figure 5.**  
Regression plot ( $R^2=10\%$ ,  $p<.05$ ).



**Figure 6.**  
Regression plot ( $R^2=8\%$ ,  $p<.05$ ).



**Figure 7.**  
Regression plot ( $R^2=9\%$ ,  $p<.05$ )



**Figure 8.** Regression plot. Greater smiling (zygomatic activity) during book selection predicted greater percentage of goodwill-themed books selected across the entire task ( $R^2=18\%$ ,  $p<.05$ ).

Table 1

Average empathy ratings and EMG activation pattern by video (N=68). "Harris Family" episode from Extreme Makeover: Home Edition.

Video	Length (seconds)	Empathic Concern (Mean score)	SD	Empathic Happiness (Mean score)	SD	Average (Mean) Zygomatic Activation	SD	Average (Mean) Corrugator Activation	SD
clip 1 (neutral)	22	0	0	1.38	1.584	0.0441	0.350	-0.0862	0.229
clip 2	18	1.53	1.126	.04	.270	-0.1498	0.584	0.0888	0.325
clip 3	58	.54	1.309	2.54	1.215	0.0022	0.520	0.0657	0.273
clip 4	35	2.59	1.417	.82	1.403	-0.1384	0.517	0.1598	0.332
clip 5	82	.34	1.205	2.66	1.512	0.5328	0.678	0.0777	0.381
Clip 6	84	.96	1.491	1.82	1.445	0.0347	0.517	0.1543	0.339
clip 7	71	1.09	1.494	1.49	1.501	0.0922	0.555	0.0017	0.394
clip 8	17	.33	1.168	1.86	1.538	0.1455	0.590	-0.0854	0.080
clip 9 (neutral)	65	.25	.662	1.00	1.358	-0.0462	0.358	0.0903	0.234
clip 10	49	.13	.694	1.66	1.462	0.0110	0.476	0.0602	0.336
clip 11	21	1.03	1.291	1.10	1.372	-0.1557	0.514	0.0630	0.329
clip 12	59	0.39	1.175	1.91	1.486	0.0286	0.593	0.0768	0.356
clip 13	151	.55	1.383	2.50	1.438	0.2240	0.552	0.1091	0.352
clip 14	54	0.49	1.382	2.89	1.336	0.3299	0.600	0.0290	0.437
clip 15	86	1.20	1.912	2.31	1.413	0.4043	0.632	0.0975	0.497
clip 16	39	0.60	1.530	2.40	1.409	0.4518	0.671	0.0056	0.431
clip 17	385	0.37	1.283	1.68	1.252	0.3360	0.635	-0.0264	0.383
clip 18	128	0.29	1.14	2.24	1.479	0.4616	0.627	0.1087	0.413



**Table 2**

Correlations between state and trait measures of empathy subtypes.

		<b>Empathic Concern (TASK)</b>	<b>Empathic Concern (IRI) (TRAIT)</b>	<b>Empathic Happiness (PES) (TRAIT)</b>
Empathic Happiness (TASK)	Pearson Correlation	.258*	.273*	.272*
	Sig. (2-tailed)	.033	.024	.025
	N	68	68	68
Empathic Concern (TASK)	Pearson Correlation		.257*	.298*
	Sig. (2-tailed)		.034	.014
	N		68	68
Empathic Concern (IRI) (TRAIT)	Pearson Correlation			.469**
	Sig. (2-tailed)			.000
	N			68

**Table 3**

Zygomatic EMG Model.

Predictor	Coefficient	Significance
Intercept	-.802	.001
K-Bit-2 Full Scale IQ percentile	.001	.397
Book Familiarity	.004	.005
Social Desirability	-.006	.370
Average DPES score (Trait positive affect)	.073	.074
<b>Task Empathic Happiness</b>	<b>.084</b>	<b>.049</b>
Trait Empathic Happiness (PES)	.001	.692
Zygomatic activity during video 3	.069	.254
Zygomatic activity during video 5	-.012	.722
Zygomatic activity during video 13	.008	.933
<b>Zygomatic activity during video 14</b>	<b>.159</b>	<b>.010</b>
Zygomatic activity during video 15	-.076	.265
Zygomatic activity during video 16	-.114	.258
Zygomatic activity during video 18	-.055	.292

Dependent variable = Percentage of goodwill-themed books selected during the second "happy" half

**Table 4**

Corrugator EMG Model.

Predictor	Coefficient	Significance
Intercept	-.068	.730
K-Bit-2 Full Scale IQ percentile	.000	.905
Book Familiarity	.001	.402
Social Desirability	-.005	.513
Average Task Personal Distress score	.106	.600
<b>Trait Empathic Concern (IRI)</b>	<b>.013</b>	<b>.042</b>
<b>Corrugator activity during video 4</b>	<b>.166</b>	<b>.021</b>
Task Empathic Concern Score	.016	.800

Dependent variable = Percentage of goodwill-themed books selected during the first "sad" half