Emotional Tears: An Honest Signal of Trustworthiness Increasing Prosocial Behavior?

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Abstract
How do our emotional tears affect the way we are treated? We tested whether tears, paired with either a neutral or a sad facial expression, elicited prosocial behavior among perceivers. Participants viewed a video clip depicting a confederate partner with or without tears displaying either a neutral or sad facial expression before making a behavioral decision in one of two economic games. In a Trust game (Experiment 1), participants who played the role of the investor were more likely to share an endowment after viewing a confederate trustee with tears (paired with either a neutral or a sad facial expression) in comparison to a confederate trustee without tears. However, in a Dictator game (Experiment 2), participants who played the role of allocator were no more likely to share an endowment after viewing a confederate recipient with tears (paired with either a neutral or sad facial expression) in comparison to a confederate recipient without tears. Taken together, these findings suggest that tears increase prosocial behavior by increasing trustworthiness as opposed to generally increasing other-regarding altruistic tendencies.

Keywords
tears, facial expression, trust, game theory, prosocial

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What do tears communicate? Intuitively, tears seem to accent experiences and expressions of emotion. For example, tears can make an expression of distress appear more acute and an expression of happiness appear more deeply moving. This intuitive notion has empirical support. Previous studies suggest that people judge faces with tears as more emotional than those without (Reed, Deutchman, & Schmidt, 2015). This brings forth two important questions. First, why do tears have this effect? That is, what property or properties of tearing accentuate emotions? Second, what is the function of communicating an accented emotion to others?

It has been proposed that emotional tears act as a signal (Fridlund, 1994; Gracanin, Bylsma, & Vingerhoets, 2018; Hasson, 2009; Nelson, 2005; Vingerhoets & Bylsma, 2016). A signal is any act or structure that influences the behavior of other organisms that also (a) evolved for its effect on other organisms and (b) is effective because of the other organisms’ evolved response to the signal (Maynard Smith & Harper, 2003; Scott-Phillips, Blyth, Gardner, & West, 2012). Explicit in the definition of a signal is that it is beneficial to both the signaler and receiver (Fridlund, 1994). Any signal that provided no benefit to the receiver would become ignored. And, as a result, any signal that is ignored by receivers would no longer benefit the signaler and would become cost prohibitive (Dezecache, Mercier, & Scott-Phillips, 2013; McCullough & Reed, 2015). As such, an important conceptual problem in any signaling system is explaining how it remains reliable (i.e., honest and mutually beneficial) over evolutionary time (McCullough & Reed, 2015).

An important insight toward this conceptual problem was proposed by Hasson (2009) who noted that a specific property of tearing is the diffusion of light and blurring of vision. This decrease in visual acuity costs the signaler by decreasing their...
ability to attack and defend themselves from others. This property may render tearing prohibitively costly in all situations that do not bring benefits great enough to overcome these costs. This suggests that tearing may serve as a handicap (Bradbury & Vehrencamp, 1998; Hasson, 1997; Maynard Smith & Harper, 2003; Zahavi, 1975; Zahavi & Zahavi, 1997) and specifies a property of tearing that might accentuate emotional experiences and expressions.

Previous literature suggests that the act of tearing honestly signals appeasement, nonaggressive and nonthreatening intentions, submission (Gracanin, Bylsma, et al., 2018; Hasson, 2009), neediness (Fridlund, 1992; Nelson, 2005), and powerlessness (Vingerhoets & Cornelius, 2001; Vingerhoets, Baehouwer, Van Tilburg, & Van Heck, 2001). In specific situations, these may serve as benefits that overcome the inherent costs typically present in tearing. Furthermore, its proposed function is to facilitate empathic cooperative and comforting behaviors from others (Gracanin, Bylsma, et al., 2018; Hendriks, Croon, & Vingerhoets, 2008; Vingerhoets & Bylsma, 2016) in times of decreased fitness, loss, helplessness, and need (Gracanin, Bylsma, et al., 2018; Nesse, 1990; Vingerhoets, van Geuken, van Tilburg, & van Heck, 1997).

This conceptualization is consistent with results from several judgment studies comparing perceptions of static images with and without tears. These studies found that images without tears are judged to be less sad (Provine & Brocato, 2009; Reed et al., 2015; Zeifman & Brown, 2011), less helpless (Vingerhoets, van de Ven, & van der Velden, 2016), less in need of emotional support (Balsters, Krahmer, Swerts, & Vingerhoets, 2013), more aggressive (Hendriks & Vingerhoets, 2006), and more competent (van de Ven, Meijs, & Vingerhoets, 2017) than those with tears. It is also consistent with a study using vignettes of individuals who did and did not cry in which participants reported they’d be more likely to give emotional support and express less negative affect toward those who cried in comparison to those who did not cry (Hendriks, Croon, & Vingerhoets, 2008). Finally, it is consistent with a behavioral study demonstrating that pictures of faces with tears facilitates behavior that reduces the distance between the receiver and signaler (Gracanin, Krahmer, Rinck, & Vingerhoets, 2018).

Taken together, these studies support Hasson’s (2009) insight that tearing may serve as a handicap. They also suggest that the function of tearing is to influence receiver judgments in ways that affect the expression of emotion and facilitate prosocial behaviors (i.e., those behaviors intended to benefit others). However, it remains to be seen whether the results from these judgment studies generalize to studies measuring prosocial behavior. Here, we examine the function of tears in the Trust game (Berg, Dickhaut, & McCabe, 1995). The Trust game models a situation in which an honest signal of appeasement might benefit both the signaler and receiver by increasing prosocial behavior of the receiver.

Participants played the role of the investor instructed to either keep or share funds with a trustee portrayed by a confederate posing one of four expressions: neutral without tears, neutral with tears, sadness without tears, and sadness with tears. It was hypothesized that participants viewing the expressions with tears (with both neutral and sad expressions) would perceive signalers to be more trustworthy and thus be more likely to share funds in comparison to those viewing the expressions without tears. We also explored whether participants viewing the sad expressions (both with and without tears) would be more likely to share funds in comparison to those viewing the neutral expressions. Finally, based on previous research demonstrating that expressions with tears are judged as more emotional than expressions without tears, we explored whether tears interact with sad expressions to elicit more frequent prosocial behavior than either factor alone.

### Experiment 1

#### Method

**Participants**

One hundred and fifty-nine participants (89 males, 70 females) were recruited using Amazon’s Mechanical Turk (MTurk), a crowdsourcing web service that coordinates the supply and demand of human interaction tasks. MTurk has been used in previous research in psychology and provides a supportive infrastructure for participant recruitment, screening, payment, and cultural diversity (Buhrmeister, Kwang, & Gosling, 2011; Horton, Rand, & Zeckhauser, 2011). Participants’ mean age was 33.21 (SD = 8.82), and their racial distribution was as follows: 81.1% Caucasian, 11.3% African American, 3.1% Asian American, and 4.4% Other. In a between-subjects design, participants were randomly assigned to view one of four expressions: neutral without tears (n = 37), neutral with tears (n = 38), sad without tears (n = 42), or sad with tears (n = 42).

**Trust Game**

Participants played the role of the investor in a variant of the Trust game (Berg et al., 1995; Camerer & Weigelt, 1988). The Trust game involves two players: the investor and the trustee. The investor begins with a sum of money (say 10 cents) which can either be kept or invested in the trustee. If the investor keeps the money, the game ends with the investor earning 10 cents and the trustee earning nothing. The game continues if the investor invests in the trustee. In this case, the money invested is tripled and the trustee then chooses to either retain or split the money with the investor. If the trustee retains the money, they earn 30 cents and the investor earns nothing. If the trustee splits the money, both players earn 15 cents.

Here, trust is defined as a wager that the trustee will behave reciprocally and split the tripled sum. Trustworthiness is defined as a split of the tripled sum. Trust is risky because a trustee motivated solely by rational self-interest would be expected to keep the entire investment for themselves. As such, an investor anticipating a self-interested trustee might be less likely to invest.
The game was described to participants using a fictional backstory to provide a specific context for the interaction. Participants read that they would play the role of a merchant (investor) who trades with farmers (trustees):

You are a merchant who trades with farmers. In your business, you can choose to give a bag of seeds to a farmer that is worth 10 cents. With these seeds, the farmer can grow a yield of crops that is worth 30 cents. If the farmers cannot grow crops, they will starve. After growing the crops, the farmer can choose to keep them all or share half of them with you.

Next, the participant read the specific rules for their interaction with the farmer (trustee):

1. You decide whether or not to give a bag of seeds to the farmer for 10 cents.
2. The farmer uses the seeds to grow crops worth 30 cents.
3. The farmer decides whether or not to share the crops with you. There is about a 25% chance the farmer will share with you and a 75% chance the farmer will not share with you.

Participants then read the earnings from the game based on their and their partner’s decisions:

If you decide not to give seeds to the farmer, you will earn 10 cents and the farmer will earn 0 cents.
If you decide to give seeds to the farmer, you will earn 15 cents if the farmer decides to share with you and 0 cents if the farmer decides not to share with you.

Participants were then told that they would see a brief video clip and written message (see below) that is typical of a farmer in this situation before deciding whether to give seeds. Finally, participants were required to correctly answer three comprehension questions before continuing the experiment (e.g., “If you give me seeds, I will be able to grow crops” placed directly below the video. After viewing the clip, the actress displayed a neutral expression throughout. In the sad clip, the actress began with a neutral expression. At exactly the 1-s mark, the actress simultaneously displayed AU's characteristic of sadness (AU1, inner eyebrow raiser; AU4, brow furrower; and AU15, lip corner lowerer), which were held until the end of the clip. The intensity of these AUs did not differ between the sad clips recorded with and without tears (see below).

As mentioned above, previous studies have created stimuli by adding or removing tears from static images. Here, we used video clips rather than static images because they provide more information to perceivers (Ambadar, Schooler, & Cohn, 2005) and, we believed, would seem more authentic to participants. Rather than risk the introduction of visual noise by digitally adding tears to the recorded video, we chose to record two neutral clips and two sad clips. In the No Tear (NT) conditions, the actress recorded the neutral and sad clips as instructed. In the Tear (T) conditions, the actress irrigated her left and right eyes with eye drops to simulate visible tearing before recording as instructed. The use of eye drops to simulate visible tears has been used in previous research (Hendriks & Vingerhoets, 2006; Reed et al., 2015) and without adversely affecting the authenticity of the video clip (Reed et al., 2015).

Each clip was recorded at 30 frames per second in full color at a resolution of 1,920 × 1,080 pixels. As such, these clips were similar in length to the average 4–6 s reported for spontaneous expressions (Frank, Ekman, & Friesen, 1993; Schmidt, Ambadar, Cohn, & Reed, 2006). Each clip was paired with a written statement. “If you give me seeds, I will be able to grow crops” placed directly below the video. After viewing the clip and paired statement, participants were asked, “Will you give your bag of seeds?” and given the option to either “give” or “do not give.” After this behavioral decision, participants were asked to rate how happy, sad, angry, fearful, disgusted, and trustworthy the farmer felt on 7-point Likert-type scales ranging from 1 = not at all to 7 = extremely. Finally, participants reported their demographic information.

**Facial Expression Stimuli**

Facial expression stimuli were brief video clips of an actress instructed to display facial actions described in the Facial Action Coding System (FACS; Cohn & Ekman, 2005). The FACS is a comprehensive and anatomically based system for describing and measuring facial movements. The FACS allows for the creation and coding of facial muscle configurations as combinations of individual action units (AUs; Ekman & Friesen, 1978; Ekman, Friesen, & Hager, 2002), providing an objective and reliable measure of facial behavior. Individual AUs were coded independently by two certified FACS and quantified using $K$, which corrects for chance agreement. Agreement between the two coders was almost perfect ($K = .97$; Landis & Koch, 1977).

Video clips were created using methods similar to Reed, Deutchman, and Schmidt (2015) and Reed, Stratton, and Rambeas (2018). Briefly, we used an audible (but unrecorded) metronome to create clips lasting 6 s in duration. In the neutral clip, the actress displayed a neutral expression throughout. In the sad clip, the actress began with a neutral expression. At exactly the 1-s mark, the actress simultaneously displayed AUs characteristic of sadness (AU1, inner eyebrow raiser; AU4, brow furrower; and AU15, lip corner lowerer), which were held until the end of the clip. The intensity of these AUs did not differ between the sad clips recorded with and without tears (see below).

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**Results and Discussion**

As a manipulation check, we first examined participants’ sadness ratings for the neutral and sad expressions in the T and NT conditions. A 2 × 2 analysis of variance (ANOVA) revealed significant main effects for tearing, $F(1, 159) = 12.45, p = .001$, and expression $F(1, 159) = 25.52, p < .001$. Importantly, there was also a significant interaction between tearing and expression, $F(1, 159) = 12.15, p = .001$. Independent samples t tests revealed that the neutral expression was rated as significantly less sad in the NT condition ($M = 3.47, SD = 1.71$) in comparison to the T condition ($M = 5.29, SD = 1.53$), $t(73) = -4.86, p < .001$. In contrast, the sad expression was not rated
Table 1. Participants’ Emotion Ratings of Campaign Managers, Experiment 1.

| Rating     | Neutral  | Sad       |
|------------|----------|-----------|
|             | No Tears | Tears     | No Tears | Tears     |
| Sad        | 3.47 (1.71)\textsubscript{A} | 5.29 (1.53)\textsubscript{B} | 5.76 (1.66)\textsubscript{B} | 5.77 (1.62)\textsubscript{B} |
| Trustworthy| 3.49 (1.87)\textsubscript{A} | 4.43 (1.50)\textsubscript{B} | 4.28 (1.56)\textsubscript{B} | 4.23 (1.36)\textsubscript{B} |

Note. Means with nonoverlapping subscripts differ significantly at \(p < .05\) by Bonferroni correction.

Figure 1. Percent of participants who kept and shared funds by expression in the Trust game, Experiment 1.

differently in the NT (\(M = 5.76, SD = 1.66\)) and T (\(M = 5.77, SD = 1.62\)) conditions, \(t(82) = -0.03, p = .974\).

We then examined participants’ trustworthiness ratings for the neutral and sad expressions in the T and NT conditions (see Table 1). A 2 \(\times\) 2 ANOVA revealed no significant main effect for tearing, \(F(1, 159) = 3.24, p = .074\), or expression, \(F(1, 159) = 1.41, p = .237\). However, there was a significant interaction between tearing and expression, \(F(1, 159) = 3.965, p = .048\). Independent samples \(t\) tests revealed that the neutral expression was rated as significantly less trustworthy in the NT condition (\(M = 3.49, SD = 1.87\)) in comparison to the T condition (\(M = 4.43, SD = 1.50\)), \(t(73) = -2.43, p = .018\). In contrast, the sad expression was not rated differently in the NT condition (\(M = 4.28, SD = 1.56\)) in comparison to the T condition (\(M = 4.23, SD = 1.36\)), \(t(82) = 0.149, p = .882\).

Data pertaining to the primary analyses are shown in Figure 1. A binary logistic regression analysis was conducted to examine the main effects of tears, the main effect of expression, and their interaction on sharing. The fit of the model was significant, \(\chi^2 = 8.90, p = .031\). Specifically, there was a main effect for tears, \(\beta = -1.29, p = .020\), odds ratio (\(OR\)) = 0.275, no main effect for expression, \(\beta = -0.916, p = .069\), \(OR = 0.400\), and tears did not interact with expression, \(\beta = 0.799, p = .320\), \(OR = 2.222\). Follow-up \(\chi^2\) analyses revealed that, among the neutral clips, a significantly greater proportion of participants who viewed the tearing video shared (32/38 or 84%) in comparison to those who viewed the nontearing video (22/37 or 59%), \(\chi^2(1) = 5.68, p = .016\). However, among the sad clips, there was no difference in sharing between the proportion of participants who viewed the tearing video (33/42 or 79%) and the nontearing video (36/42 or 86%), \(\chi^2(1) = 0.73, p = .285\).

Following these primary analyses, we conducted two additional binary logistic regression analyses using sadness and trustworthiness ratings to predict sharing. The analyses revealed that sadness ratings were not a significant predictor of sharing, \(\chi^2 = 1.01, p = .316\), and the neutral expression \(\beta = -1.00, p = .313\), \(OR = 0.905\). Trustworthiness ratings, however, significantly predicted sharing, \(\chi^2 = 65.96, p < .001\), \(\beta = -1.288, p < .001\), \(OR = 0.276\).

Having found an effect of tears on sharing among the neutral expressions, we examined whether this effect was mediated by ratings of trustworthiness. We did this analysis using the probit link for the binary choice outcome in Mplus 8.3 (Muthen, Muthen, & Asparouhov, 2017) and tested the indirect effect using percentile bootstrap confidence intervals based on 1,000 bootstrap samples. We designate the total, indirect, and direct effects using Baron and Kenny (1986) notation of \(c, a \times b\), and \(c'\), respectively. The total effect of tears on sharing was \(c = .763 (95\% CI [0.192, 1.542])\), and it was decomposed into an indirect effect of \(a = .434 (95\% CI [0.064, 0.895])\) and direct effect \(c' = .329 (95\% CI [-0.142, 0.983])\). The indirect effect was statistically significant and accounted for 57% of the total effect, indicating at least partial mediation of the tear effect through ratings of trustworthiness.

These results support the hypothesis that tears increase trust and motivate prosocial behavior. In neutral expressions, participants were more likely to share when viewing the clip with tears in comparison to the clip without tears. In contrast, participants who viewed the sad expressions (both with and without tears) were no more likely to share than those who viewed the neutral expressions.

Experiment 2

Method

The prosocial behavior seen among participants who viewed the tearing clips in Experiment 1 could be the result of increased trust (i.e., certainty that the trustee will behave reciprocally and split the tripled sum). However, these findings could also be the result of increased other-regarding altruistic preferences (Cox, 2004). That is, participants viewing expressions with tears may have been more likely to share not because they believed the trustee would act reciprocally, but because they were willing to forfeit their share in order to help the trustee.

Experiment 2 distinguishes between these two explanations by removing the trustee’s choice to split or keep the tripled sum. This manipulation makes trustworthiness (the likelihood to split the tripled sum) irrelevant and changes the Trust game into a Dictator game (Eckel & Grossman, 1996). Here, we put
participants in the role of the allocator in a Dictator game and examined transfers to recipients portrayed using the same expressions used in Experiment 1.

**Participants**

A second set of 159 participants (90 males, 69 females) were also recruited using Amazon’s MTurk. Participants’ mean age was 34.05 (SD = 8.82), and their racial distribution was as follows: 90.6% Caucasian, 5% African American, 1.3% Asian American, and 3.2% Other. Participants were randomly assigned to view one of four expressions: neutral without tears (n = 41), neutral with tears (n = 40), sad without tears (n = 39), or sad with tears (n = 39).

**Dictator Game**

Participants followed the same procedure as Experiment 1 with one exception: Participants were told that the recipient would keep the tripled sum without any option to split with the participant.

**Results and Discussion**

As in Experiment 1, we first examined participants’ sadness ratings for the neutral and sad expressions in the T and NT conditions (see Table 2). A 2 × 2 ANOVA revealed significant main effects for tearing, F(1, 159) = 11.04, p = .001, and expression F(1, 159) = 24.21, p < .001. Importantly, there was also a significant interaction between tearing and expression, F(1, 159) = 10.48, p = .001. Independent samples t tests revealed that the neutral expression was rated as significantly less sad in the NT condition (M = 4.00, SD = 1.79) in comparison to the T condition (M = 5.57, SD = 1.54), t(79) = -4.23, p < .001. In contrast, the sad expression was not rated differently between the NT condition (M = 5.96, SD = 1.23) and the T condition (M = 5.98, SD = 1.41), t(76) = -0.07, p = .946.

We then examined participants’ trustworthiness ratings for the neutral and sad expressions in the T and NT conditions. A 2 × 2 ANOVA revealed no significant main effect for tearing, F(1, 159) = 0.001, p = .976, or expression, F(1, 159) = 0.030, p = .862. There was also no significant interaction between tearing and expression, F(1, 159) = 0.316, p = .575.

Data pertaining to the primary analyses are shown in Figure 2. A binary logistic regression analysis was conducted to examine the main effects of tears, the main effect of expression, and their interaction on sharing. The fit of the model was not significant, χ² = 3.544, p = .315.

As in Experiment 1, we conducted two additional binary logistic regression analyses using sadness and trustworthiness ratings to predict sharing. The analyses revealed that sadness ratings were not a significant predictor of sharing, χ² = 1.84, p = .175, β = 0.141, p = .185, OR = 1.152. Trustworthiness ratings, however, significantly predicted sharing, χ² = 27.77, p < .001, β = -0.673, p < .001, OR = 0.510.

As noted above, we found a significant main effect of tears in the Trust game (Experiment 1). However, there was no significant main effect of tears in the Dictator game (Experiment 2). As such, we conducted a final binary logistic regression combining the data from both experiments to use tearing (NT, T) and game (Trust, Dictator) to predict sharing. The fit of the model was significant, χ² = 8.739, p = .033. See Figure 3, specifically, there was no main effect for tears, β = -1.35, p = .693, OR = 0.874, a main effect for game, β = -1.022,
The results accord with studies suggesting that other displays can increase prosocial behavior in receivers. For example, smiles have been found to increase prosocial behavior by communicating cooperative intent (Reed, Zeglen, & Schmidt, 2012), angry expressions have been found to increase prosocial behavior by communicating the increased credibility of threats (Reed, DeScioli, & Pinker, 2014), and sad expressions have been found to increase prosocial behavior by communicating need (Reed & DeScioli, 2017). Future research might expand upon this by investigating the ways that other facial and emotional expressions (e.g., laughter and disgust) might influence prosocial behavior among receivers.

The results of this study must be interpreted within the context of several limitations. First, we examined the effect of tears only when paired with neutral and sad expressions. It remains possible that tears may affect receivers in different ways when paired with other expressions (e.g., pain or happiness) or with specific facial AUs (e.g., AU11; nasolabial furrow deepen). Second, our stimuli consisted of expressions displayed by a single, female actress. Although this allowed for us to successfully isolate the effects of sad expressions and tears on trust, future research is needed to determine whether these effects generalize across individuals who differ in age, race, sex, and/or culture. Regarding culture, recent research suggests that the frequency of crying varies by culture, with crying strongly discouraged in some cultures (Wikan, 1988). Regarding sex, previous research suggests that reactions to crying vary depending upon the sex of both the signaler and the receiver (Cretser, Lombardo, Lombardo, & Mathis, 1982). Considering our results, it may be hypothesized that these factors may also affect perceptions of trustworthiness and prosocial behavior. Third, participants were told they would be interacting with a random participant and viewed a video clip said to be typical of this random participant. Future research might benefit from examining the effects of tears in more immediate, face-to-face interactions. Finally, although our data suggest that tears increase prosocial behavior via trustworthiness it remains possible that other mechanisms may also be at play (e.g., knowledge of personality traits or previous behaviors).

The study of facial behavior has focused primarily on the innervation and timing of facial muscles. As others have suggested, the investigation of the ways these characteristics interact with secondary acts (e.g., emotional tearing, blushing, laughing) might be required for a broader understanding of the communicative functions of facial behavior (Provine, 2012). Such works might shed light on the ways that tears accent, temper, or otherwise nuance the communicative function of displays and expressions of emotion. They may also find that these secondary acts might act as signals that may also influence receiver’s behavior in isolation. Here, we have demonstrated that tears can communicate trustworthiness and increase prosocial behavior as one such secondary act.

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