Effects of Tearing on the Perception of Facial Expressions of Emotion

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Abstract
What is the function of emotional tearing? Previous work has found a tear effect, which resolves ambiguity in neutral expressions and increases perceptions of sadness in sad expressions. Tearing, however, is associated with a variety of emotional states, and it remains unclear how the tear effect generalizes to other emotion expressions. Here we expand upon previous works by examining ratings of video clips depicting posed facial expressions presented with and without tears. We replicate Provine et al.’s (2009) findings that tearing increases perceptions of sadness in sad expressions. Furthermore, we find that tearing has specific effects on ratings of emotion (happiness, sadness, anger, and fear) and ratings of intensity and valence in neutral, positive, and negative expressions. These results suggest that tearing may serve a specific and independent communicative function, interacting with those of various expressions.

Keywords
tear, facial expression, signaling

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Introduction
Why do humans weep? In response to physical irritation, the function of tearing (secretion of the lacrimal glands) is to restore vision by lubricating the eye. This smooths the surface of the cornea, flushes out debris, and provides antibiotic treatment (Frey, 1985; Sullivan et al., 2002). In response to emotion, there is no obvious or accepted explanation. Emotional tears have the potential cost of reducing visibility (Bradbury & Vehrencamp, 1998; Hasson, 1997). Furthermore, this cost is often incurred in intensely affective social situations involving rich emotional signals, at a time when increased visibility would seem advantageous. In light of these costs, what is the functional benefit of emotional tearing?

An answer may lie in the interpersonal effects of tearing on observers. In comparison to neutral, angry, and fearful faces, crying faces have been found to elicit greater feelings of sadness among observers (Hendricks & Vingerhoets, 2006; Labott, Martin, Eason, & Berkey, 1991). It has been suggested that these feelings may deter aggressive behaviors (Kottler & Montgomery, 2001) and/or promote attention and motivate support from others (Frijda, 1997; Vingerhoets, Cornelius, Van Heck, & Becht, 2000).

Intrapersonally, tears diffuse light and blur vision, impairing the ability to attack and defend. Coupled with sadness, these costs may qualify crying as a handicap (Bradbury & Vehrencamp, 1998; Hasson, 1997; Maynard Smith & Harper, 2003; Zahavi, 1975; Zahavi & Zahavi, 1997), honestly signaling appeasement and/or neediness toward others (Frijdlund, 1992; Nelson, 2005; Hasson, 2009). As such, the benefit of emotional tearing may lie in its ability to serve as an honest emotional signal, influencing the ways in which sadness expressions are perceived.

Emotional tears are most commonly associated with expressions of sadness felt in situations associated with decreased fitness and loss (Nesse, 1990). Furthermore, recent empirical work suggests that emotional tears increase receiver perceptions of sadness (Balsters, Krahmer, Swerts, & Vingerhoets, 2012; Provine & Brocato, 2009) and sincerity (Zeifman & Brown, 2011). In a study comparing static images of individuals with and without tears, Provine, Krosnowski, and Brocoto

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(2009) found that individuals portrayed with tears were perceived as sadder in appearance. Furthermore, it was found that individuals portrayed without tears were rated more ambiguously in comparison to those with tears, suggesting that emotional tearing may function as a specific marker of sadness. Consistent with these findings, Balsters, Krahmer, Swerts, & Vingerhoets (2012) found that tears added digitally to existing photos of emotion expressions facilitated the perception of emotion and perceived need for support in images of both neutral and sad individuals. Together, these studies suggest a tear effect, in which tears increase the perception of sadness in sad expressions.

Emotional tearing, however, is not restricted to sadness. Tearing has been associated with other emotional states such as grief, despair, frustration, helplessness, powerlessness, pain, happiness, anger, and empathy. Similarly, tears are shed in situations characterized by both loss and conflict as well as experienced powerlessness and perceived lack of adequate coping mechanisms (Vingerhoets & Cornelius, 2001; Vingerhoets, Boelhouwer, Van Tilburg, & Van Heck, 2001). Furthermore, crying has been associated with nonemotional acts such as yawning, laughing, and sneezing (Frey, 1985; Lutz, 1999; Provine, 2000; Vingerhoets & Cornelius, 2001).

In light of previous work on the effect of tearing on static facial images and the presence of tearing across emotional states, the aim of the current study was to examine emotion ratings of prototypic facial expressions of emotion with and without tears. Here, we used video clips rather than static images because they provide more information to perceivers (Ambadar, Schoeler, & Cohn, 2005). Based on the previous literature on static expressions, we hypothesized that tears would serve as a specific marker of sadness across emotional expressions. Following from the idea that tears honestly signal appeasement, we hypothesized that clips depicting facial expressions with tears would be rated with greater generalized intensity and with more generalized negative valence in comparison to those without tears.

Material and Method

Participants

One hundred eight participants (62 males and 46 females) were recruited on Amazon’s Mechanical Turk (MTurk), an online crowd-sourcing website at which individuals sign up to complete tasks. MTurk has been used in previous research in psychology and experimental economics and has a large and diverse subject pool (Buhrmeister, Kwang, & Gosling, 2011; Horton, Rand, & Zeckhauser, 2011). Participants’ mean age was 37.26 (SD = 11.48), and their racial distribution was as follows: 82.4% Caucasian, 6.5% African American, 7.4% Asian American, and 4% other. Each participant provided ratings for each expression in a within-subjects design.

Stimuli

A female actress (18 years old, Caucasian) was instructed to create facial actions characteristic of prototypic emotions using the Facial Action Coding System (FACS; Cohn & Ekman, 2005). FACS is a comprehensive, anatomically based system for describing and measuring facial movement. FACS allows for the creation and coding of all possible facial muscle configurations as combinations of individual action units (AUs; Ekman & Friesen, 1978; Ekman, Friesen, & Hager, 2002), providing an objective and reliable method of measuring facial behavior. Expressions produced by the actress included those characteristic of enjoyment (non-Duchenne smiles: AU 12; lip corner raiser and Duchenne smiles: AU 6; cheek raiser, AU12; and lip corner raiser), sadness (AU 1, inner eyebrow raiser; AU4, brow furrower; AU 15, lip corner lowerer; and AU 64, eye gaze downward), fear (AU 1, inner eyebrow raiser; AU 2, outer eye-brow raiser; AU 5; eyelid raiser; AU 25 lips part; and AU 26, jaw drop), and anger (AU 4, brow furrower; AU 5, eyelid raiser; and AU 24, lip presser). All expressions were independently coded by the first author and a comparison coder certified in FACS and quantified using k, which corrects for chance agreement. Reliability for coding was very good (K = .88).

Rather than digitally manipulating the appearance of tears in these videos and risking the introduction of noise into the visual signal, we chose to record two separate conditions for each emotion assessed. In the No Tear (NT) condition, each expression was recorded as instructed. In the Tear (T) condition, each expression was created after irrigating the left and right eyes (with eye drops) to simulate visible tearing.

Each clip was recorded at 30 frames per second in full color at a resolution of 1260 × 1080 pixels. This resulted in clips similar in length to the average 4 to 6 s reported for spontaneous expressions (Frank, Ekman, & Friesen, 1993; Schmidt, Ambadar, Cohn, & Reed, 2006). We used video clips rather than static images because they provide more information to perceivers (Ambadar et al., 2005).

Procedures

Participants were given a consent form and a description of the procedure. Clips were presented in a randomized order on two consecutive webpages followed by a set of 7-point Likert-type scales. On the first page, participants reported generalized intensity (“Generally, how intense is the emotion that this person is feeling?” from 1 “Not at all” to 7 “Extremely”) and valence (“Generally, how negative or positive is the emotion that this person is feeling?” from 1 “Negative” to 4 “Neutral” to 7 “Positive”). On the second page, participants reported the intensity of five specific emotions (happiness, sadness, anger, fear, and disgust) on separate scales (“Please use the following scales to rate how this person feels” from 1 “Not at all” to 7 “Extremely”).

Results

Preliminary Results

As noted earlier, clips in the T condition were created by irrigating the left and right eyes to simulate visible tearing. To
ensure that expressions depicted in the T condition were perceived as credible, we recruited an additional sample of 30 Mturk participants to rate the authenticity of each clip. Clips were presented in a randomized order followed by a 7-point Likert-type scale measuring authenticity (“Generally, how authentic is the expression that this person is making?” from 1 “Not at all” to 7 “Extremely”).

A paired samples t-test showed no significant difference in authenticity between clips in the T condition (M = 4.29, SD = 1.74) and those in the NT condition (M = 4.28, SD = 1.80), t(179) = .06, p = .952, d = .005. Further analyses showed no significant differences in authenticity between clips in the T condition and the NT condition for neutral, t(29) = 0.91, p = .372, d = .164; sad, t(29) = 1.12, p = .273, d = .203; non-Duchenne, t(29) = −1.56, p = .129, d = −.285; Duchenne, t(29) = 1.78, p = .086, d = .323; anger t(29) = −.86, p = .399, d = −.157; or fear, t(29) = −2.02, p = .053, d = −.366, clips.

**Primary Results**

Mean participant ratings of clips in the NT and T conditions and effect sizes of paired samples t-tests are presented in Table 1. Regarding intensity, participants rated the neutral, Duchenne smile, anger, and fear clips as more intense in the T condition than in the NT condition, with the strongest effects shown for the neutral and fear clips. No significant differences in generalized intensity were found for the non-Duchenne smile and sadness clips. Reported ratings of generalized valence (positive or negative) showed that the neutral, non-Duchenne smile, anger, and fear clips were rated more negatively in the T condition than in the NT condition. The effects for the neutral, non-Duchenne, and fear clips showed the largest effect sizes (respectively), while the anger clip showed a smaller effect size. No significant differences in valence were found for the Duchenne smile and sad clips.

Similar to those results on valence, happiness ratings were significantly lower in the T condition than the NT condition for neutral, non-Duchenne smile, and fear clips. As expected, sadness ratings were significantly higher in the T condition than the NT condition for neutral, non-Duchenne smile, Duchenne smile, sad, and fear clips. For both happiness and sadness ratings, the strongest effect sizes were found for comparisons of the neutral clip, suggesting that the tear effect is most salient in the absence of a positive or negative valence. Anger ratings were significantly higher in the T condition than the NT condition for neutral, non-Duchenne smile, anger, and fear clips. Finally, fear ratings were mixed. Ratings were significantly higher in the T condition than the NT condition for the neutral and non-Duchenne smile clips but were significantly lower in the T condition than the NT condition for the sad clip.

**Discussion**

The aim of the current study was to investigate the effect of tears on perceived emotion ratings of prototypic facial expressions. We found that tearing enhanced perceptions of sadness among sad expressions. Furthermore, our results suggest that the tear effect has both generalized and specific effects on the perception of emotion. To our knowledge, this is the first study to examine the effect of tears across both positive and negative expressions.

Consistent with previous work showing that tears serve as a specific marker of sadness, sadness ratings were greater among neutral, non-Duchenne smile, Duchenne smile, sad, and fear clips when presented with tears in comparison to without tears. Moreover, this effect was greatest in the comparison of the neutral clips with and without tears. That is, the neutral clip with tears was perceived with almost as much sadness as the sad clip without tears, suggesting that tearing alone is a sufficient marker of sadness. No difference was found regarding sadness ratings for the two anger clips. One explanation for this exception could lie in the juxtaposition of two emotions (sadness and anger) with opposing approach-withdrawal systems (Davidson, Ekman, Saron, Senulis, & Friesen, 1990). This suggests that tearing serves as a signal enhancing perceptions of sadness across approach-related emotional expressions.

Tears increased the intensity of neutral expressions as well as those representing Duchenne smiles, anger, and fear. Although nonsignificant, we found that non-Duchenne smiles were rated as less intense when presented with tears. This is of particular interest when compared with the intensity ratings of Duchenne smiles. It is possible that tears in the non-Duchenne smile clip were interpreted as a marker of sadness, counteracting the usually positive non-Duchenne smile signal, while tears in the Duchenne smile clip were interpreted as a marker of increased happiness or tears of joy. This interpretation is consistent with the ratings of valence, which were more positive among Duchenne smiles than non-Duchenne smiles when presented with and without tears. Contrary to our hypothesis, ratings of generalized intensity for the sad clip with tears did not differ from the sad clip without tears. That is, tears increase the sadness ratings among the sad clips but did not increase intensity ratings among the sad clips. One interpretation is that sadness, a more passive emotion, is not readily associated with intensity.

Finally, tears decreased the generalized valence of neutral, non-Duchenne, anger, and fear expressions, although only marginally significant effects were found for Duchenne-smile and sad expressions. This suggests that the presence of tears serve as a marker that generally increases perceptions of negativity in emotional expressions.

Several limitations need to be taken into consideration in the interpretation of our results. The present study aimed to examine the effect of tears using video clips rather than static images. Our stimuli were deliberately rather than spontaneously created. Thus, although we were able to manipulate the configuration of specific facial actions, documented differences in the timing characteristics of deliberate when compared to spontaneous expressions may have influenced participant ratings (Schmidt et al., 2006). Future research could benefit from investigating the tear effect in both spontaneously and deliberately induced expressions. In addition, our data are
Table 1. Participant Ratings.

|               | Intensity | Valence | Happy | Sad | Afraid |
|---------------|-----------|---------|-------|-----|--------|
|               | Mean      | SD      | d     | Mean| SD     | d     |
| Neutral       |           |         |       |     |        |       |
| No Tears      | 2.09      | 1.26    | -0.89 | 4.04| (0.49) | 1.31  |
| Tears         | 3.78      | 1.64    | 2.54  | 1.08| 1.38   | 0.76  |
| Non-Duchenne smile |   |         |       |     |        |       |
| No Tears      | 2.91      | 1.15    | 0.14  | 4.90| (0.88) | 0.73  |
| Tears         | 2.72      | 1.36    | 3.98  | 0.93| 3.73   | 1.35  |
| Duchenne smile |           |         |       |     |        |       |
| No Tears      | 5.49      | 1.81    | -0.32 | 6.33| (0.71) | 0.08  |
| Tears         | 5.91      | 1.08    | 6.26  | 0.90| 6.36   | 0.81  |
| Sad           |           |         |       |     |        |       |
| No Tears      | 4.22      | 1.42    | -0.22 | 2.15| (0.83) | 0.13  |
| Tears         | 4.55      | 1.39    | 2.01  | 0.83| 1.23   | 0.53  |
| Anger         |           |         |       |     |        |       |
| No Tears      | 4.14      | 1.27    | -0.28 | 2.48| (0.83) | 0.34  |
| Tears         | 4.54      | 1.20    | 2.12  | 0.81| 1.26   | 0.67  |
| Fear          |           |         |       |     |        |       |
| No Tears      | 4.62      | 1.14    | -1.10 | 2.86| (0.99) | 0.95  |
| Tears         | 5.93      | 1.08    | 1.78  | 0.87| 1.16   | 0.41  |

Note. All ratings were reported on a 7-point Likert-type scale. Bold Cohen’s d denotes significant effect sizes.

self-reported. Although this accurately captures perceptions of expressions, future work would benefit from investigating the behavioral effects of expressions (eg, using game theory).

Our results suggest that tears affect the ways that we perceive facial expressions of emotion, serving as an honest signal of sadness. In addition to this generalized effect, our results point toward expression-specific effects on intensity and valence of emotional expressions.

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