

Provided for non-commercial research and education use.
Not for reproduction, distribution or commercial use.



This article appeared in a journal published by Elsevier. The attached copy is furnished to the author for internal non-commercial research and education use, including for instruction at the authors institution and sharing with colleagues.

Other uses, including reproduction and distribution, or selling or licensing copies, or posting to personal, institutional or third party websites are prohibited.

In most cases authors are permitted to post their version of the article (e.g. in Word or Tex form) to their personal website or institutional repository. Authors requiring further information regarding Elsevier's archiving and manuscript policies are encouraged to visit:

<http://www.elsevier.com/copyright>



Contents lists available at ScienceDirect

Journal of Research in Personality

journal homepage: www.elsevier.com/locate/jrp

When and for whom does crying improve mood? A daily diary study of 1004 crying episodes

Lauren M. Bylsma^a, Marcel A. Croon^b, Ad.J.J.M. Vingerhoets^c, Jonathan Rottenberg^{a,*}

^a Department of Psychology, University of South Florida, Tampa, FL, United States

^b Department of Methodology and Statistics, Tilburg University, Tilburg, The Netherlands

^c Clinical Psychology Section, Tilburg University, Tilburg, The Netherlands

ARTICLE INFO

Article history:

Available online 5 May 2011

Keywords:

Crying
Mood
Affect
Context
Individual differences
Daily diary
Naturalistic

ABSTRACT

We aimed to examine the connections between individual affective characteristics and crying, and to evaluate Rottenberg, Bylsma, and Vingerhoets' (2008) framework for studying crying and mood. We analyzed the relationship among features of the social environment, mood characteristics of the crier, crying frequency/urge to cry, and mood change across 1004 detailed crying episodes sampled from 97 females. Urge to cry and crying frequency were associated with poorer mood, and urge to cry was associated with greater mood variability. Poorer mood was observed both before and after crying episodes, and one-third of crying episodes resulted in reported mood improvement following crying. Benefits of crying, when they occur, are shaped by the social environment and the affective characteristics of the crier.

© 2011 Elsevier Inc. All rights reserved.

1. Introduction

Crying is a common, human form of emotional expression that can be elicited in diverse contexts (Vingerhoets, Bylsma, & Rottenberg, 2009). Given that human crying is typically triggered by emotionally meaningful events, this behavior has import for our understanding of emotion and emotion regulation. Yet even strong emotional stimuli will not evoke tears in all people, leaving considerable room for individual differences, such as psychological (mood) and physical (sleep loss) states to shape whether or not emotional tears are shed in a given situation. Consistent with a role for individual differences, a robust predictor of increased crying is neuroticism, a trait characterized by emotional instability, whereas, alexithymia, a trait characterized by a difficulty in expressing and processing emotions, predicts reduced crying frequency and poorer mood following crying (Peter, Vingerhoets, & van Heck, 2001; Rottenberg, Bylsma, Wolvin, & Vingerhoets, 2008).

A main focus of prior research on crying has been on its hypothesized adaptive functions, especially on putative psychological benefits (Rottenberg, Bylsma, & Vingerhoets, 2008; see Vingerhoets et al., 2009, for review). Many scientific theorists from multiple perspectives have posed an adaptive function of crying as serving a cathartic function to relieve tension or stress through possible

physiological (Breuer & Freud 1895/1968; Efran & Spangler, 1979; Gross, Fredrickson, & Levenson, 1994; Heilbrunn, 1955; Sadoff, 1966), biochemical (Frey, Hoffman-Ahern, Johnson, Lykken, & Tuason, 1983); behavioral coping (Miceli & Castelfranchi, 2003; Scheff, 1979), or social mechanisms (e.g., Cornelius, 1997; Kottler & Montgomery, 2001; Nelson, 2005). The idea that crying is beneficial for psychological and even physical well-being has been widespread in both popular literature and scientific theory (Cornelius, 1986); however, the empirical evidence suggests a more complicated picture.

Naturalistic survey designs typically find that when people retrospectively report about past crying episodes, most report mood benefits from crying (e.g., Bindra, 1972; Bylsma, Vingerhoets, & Rottenberg, 2008; Frey et al., 1983; Kraemer & Hastrup, 1986; Lombardo, Cretser, Lombardo, & Mathis, 1983), including reduced tension and feelings of relief (e.g., catharsis; Scheff & Buschnell, 1984). For example, Bylsma and colleagues (2008) examined over 4000 crying reports from men and women across over 30 countries and found that a majority of participants reported experiencing mood benefits from crying.

Importantly, not all participants report mood benefits from crying in retrospective survey designs, and a sizeable minority even reports negative effects on mood. For example, Lombardo et al. (1983) found that about one fifth of their sample reported negative effects of crying such as feeling depressed, embarrassed, tired, or weak. Indeed, we have been intrigued by this variation and have sought to systematically study it. In our international study analyses (Bylsma et al., 2008), receipt of social support, experienc-

* Corresponding author. Address: Department of Psychology, University of South Florida, 4202 E. Fowler Ave., PCD4118G, Tampa, FL, United States. Fax: +1 813 974 4617.

E-mail address: rottenberg@usf.edu (J. Rottenberg).

ing a resolution or a new understanding of the event that caused the crying, or crying in the context of a positive event all predicted improved mood after crying. In contrast, receipt of negative social responses from crying, experience of embarrassment or shame, or crying due to witnessing the suffering of others predicted worsened mood after crying (Bylsma et al., 2008). Thus, preliminary evidence suggests that variations in contextual characteristics may explain systematic variation in the effects of crying, and attention to these variables may help elucidate for whom and in what contexts crying may be beneficial.

Consistent with the importance of context, studies that elicit crying in a laboratory setting rarely find mood benefits from crying. Unlike what is seen in retrospective surveys, most laboratory studies find that people who cry to an eliciting stimulus (e.g., a sad film clip) report increased distress, sadness, or arousal relative to people who view the same stimulus without crying (e.g., Gross et al., 1994; Labott & Martin, 1987; Martin & Labott, 1991; Rottenberg, Gross, Wilhelm, Najmi, & Gotlib, 2002). Although laboratory and retrospective self-report studies are reasonable first steps in the field, both of these methods also have clear limitations.

Retrospective self-report studies require participants to search over long periods to identify characteristics of crying episodes, which may be infrequent events. As a result, individuals may be more likely to recall the most salient or intense crying episode rather than a typical crying episode. Further, retrospective self-report data are also vulnerable to implicit theories about (the functions of) crying. To the extent that participants subscribe to the strong lay view that crying is beneficial, implicit theories are likely to magnify reports of the benefits of crying (see Cornelius, 1986).

Laboratory designs also introduce error into the assessment of crying. There is typically only a single point assessment of crying, and the effects of crying on mood are typically evaluated only over a brief period of time. Since crying is never successfully elicited in 100% of participants and random assignment to crying is not possible, it is difficult in a laboratory design to disentangle the effects of crying from the characteristics of cry-prone individuals. In addition, because the laboratory environment is typically asocial and socially unsupportive, the crying does not impact the situation (which is depicted in the film), which may also bias studies against finding psychological benefits (Rottenberg, Bylsma & Vingerhoets, 2008).

If we are to understand the intrapersonal and interpersonal factors that mediate and moderate the effects of crying, the field must overcome methodological challenges. One is to rely less on single-point measurements and find ways to gather an ecologically valid sample of crying episodes. Repeated sampling is often achieved with computerized experience sampling (ESM). However, given the rarity of crying, there is a practical concern with ESM. To capture multiple episodes would require long and dense ESM recording protocols, creating a high participant burden and possibly inducing reactivity (i.e., dense assessment of crying may alter the behavior under study). Alternatively, the daily diary method (Bolger, Davis, & Rafaeli, 2003) can be implemented over longer periods of time with a lower participant burden than ESM. The daily diary method allows the investigator to obtain multiple crying reports for each participating individual, enhancing reliability and allowing for the estimate of within-individual effects, as well as the examination of effects of crying over time. Further, since reports are typically given at the end of each day, use of this method provides detailed assessment of crying without causing major interruption to the natural flow of daily life. Since reports are provided the same day that crying episodes occur, retrospective biases and memory errors are reduced relative to retrospective surveys (e.g., Parkinson, Briner, Reynolds, & Totterdell, 1995; Poikolainen & Karkkainen, 1983).

In the only daily diary study of the effects of crying to date, Frey and colleagues (1983) examined emotional crying reports over a 30-day period from 286 females and 45 males and found that criers reported experiencing mood improvement (i.e., reductions in sadness or anger) after 40% of the recorded episodes. However, on a trait measure that asked criers how they generally felt after a crying episode, a much larger percentage (85% of females and 73% of males) reported feeling better after crying. The wide discrepancy between daily and trait measures again highlights the importance of methodological choices and the value of methods that collect data on mood on the same day as a particular crying episode (i.e., to minimize the influence of memory errors and implicit theories of crying).

Given the varied nature of crying and its effects, Rottenberg, Bylsma and Vingerhoets (2008) developed a heuristic framework to study the psychological effects of crying. Among the domains considered by this framework are: the nature of crying triggers, how and when effects are measured, conditions in the social environment, personality traits (and other individual difference characteristics), and the affective state or disposition of the crier. Most of these domains have been related to the psychological effects of crying including: reasons/triggers for crying (Bylsma et al., 2008), individual differences in personality traits (Rottenberg, Bylsma, Wolvin et al., 2008), in affective states (Rottenberg, Cevaal, & Vingerhoets, 2008) and the presence or absence of others (Bylsma et al., 2008).

1.1. The present study

The aims of the present study thus were twofold. A first goal was to learn more about the connections between individual affective characteristics (i.e., mood and mood stability) and crying. Second, the goal was to evaluate our model (Rottenberg, Bylsma & Vingerhoets, 2008) in a stronger design, with more attention to person characteristics. To that end, we applied a daily diary methodology to examine crying episodes in young women over a period of approximately two months. Since the purpose of the original study was to examine the relationship between crying and the menstrual cycle, only females were included and data were collected for two menstrual cycles (minimum of 40 days) for each individual (van Tilburg, Becht, & Vingerhoets, 2003). The extended length of the daily diary protocol allowed for the inclusion of a large number of crying episodes, which enabled us to examine crying for the first time as a within-subjects phenomenon using sophisticated multilevel regression analyses. We could, for example, contrast crying and non-crying days for each participant and evaluate both mood as a predictor of crying and crying as a predictor of subsequent mood change. Finally, we extended Frey and colleagues' (1983) findings by including detailed analyses of the context of crying and their relationship to mood.

Although this study was novel in several respects, previous findings with retrospective survey designs helped guide hypotheses. Since we have found that persons with neuroticism (De Fruyt, 1997; Peter et al., 2001) and depression report crying more frequently and report experiencing less post-crying mood improvement relative to non-psychiatric individuals (Rottenberg, Cevaal & Vingerhoets, 2008; Vingerhoets, Rottenberg, Cevaal, & Nelson, 2007), we hypothesized that (1) high dispositional negative mood and low dispositional positive mood would be associated with greater crying frequency, and (2) poorer dispositional mood would predict less experience of mood improvement after crying. Based on our previous work examining predictors of post-crying mood improvement (Bylsma et al., 2008), we further expected that mood improvement after crying would be positively associated with: (3) crying in the presence of one other individual (relative to crying alone or with many other

individuals present), (4) experiencing a new understanding or resolution of the situation that triggered the crying, and (5) the experience of a positive event. We also predicted that (6) witnessing suffering would be negatively related to mood improvement. Finally, there has been little investigation of the relationship between crying duration or intensity and mood changes; thus, we also performed exploratory analyses of these variables.

2. Method

2.1. Participants

The sample included archival data collected from 97 female students majoring in psychology at Tilburg University in The Netherlands aged 18–48 (mean = 20.28, *sd* = 5.20). Data were part of a larger protocol examining the relationship between crying and the menstrual cycle (see van Tilburg et al. (2003), for detail). Participants, who received course credit for participation, were informed that the study concerned daily variations in emotionality.

2.2. Procedure

Participants kept a crying and mood diary for a period that ranged from 40–73 days, corresponding to the duration of two consecutive menstrual cycles. At the end of each day, there was a recording of daily mood, urge to cry during the day, and whether a crying episode occurred. If a crying episode occurred, more information was provided about the context of the crying episode, including reasons for crying, social context and situation change, duration and intensity of crying, and feelings after crying. There was good compliance with this instruction to provide detailed reports: For days in which crying was reported in the diary, the corresponding crying questionnaire was completed 90% of the time. Questions about specific crying episodes were adapted from the Adult Crying Inventory (ACI; Vingerhoets, 1995).

2.3. Measures

2.3.1. Urge to cry

Urge to cry during each day was assessed with a single item using a 7-point scale, which asked participants how much they felt like crying on a particular day.

2.3.2. Daily and dispositional mood

Daily mood was rated on a 7-point scale with the following mood indicators (translated from Dutch): nervous, cheerful, angry, relaxed, restless, tense, sad, anxious, emotionally stable, and irritable. Daily positive and daily negative mood were computed by averaging the positive (cheerful, relaxed, emotionally stable) and negative mood items (nervous, angry, restless, tense, sad, and anxious) on each day. Dispositional positive and negative mood were computed by taking the overall average of the positive and negative mood items across all days.

Internal consistencies for these indices of positive and negative mood were both acceptable (Cronbach's alpha > .80). Since the use of Cronbach's alpha for calculating internal consistency has been criticized for use in multilevel data (see Nezlek, 2007), we also used a multilevel approach to calculate reliability estimates. Using the approach described by Nezlek (2001), we calculated the person-level reliability estimates, which confirmed that the scales had high internal consistency (multilevel level-1 reliability estimates all >.70 for positive and negative affect).

2.3.3. Positive and negative mood variability

To provide within-individual estimates of positive and negative mood variability, a measure of day-to-day mood stability was calculated using the mean square successive difference (MSSD) for both daily average positive mood and daily average negative mood (see Jahng, Wood, & Trull, 2008).

2.3.4. Reasons for crying

When crying occurred, participants selected the primary reason for crying from a multiple choice list that included eight options: conflict, loss, personal failing, perceiving suffering of others, positive experience, physical condition, mental condition, combination of causes/other reason.

2.3.5. Social context of crying and situation change

Participants recorded the location of crying, the number of individuals present during the crying, and whether, and if so, how the situation changed after crying (−1 = yes, negative change, 0 = no change, 1 = yes, positive change). For the location of crying, there were seven response options: living room, bedroom, study room, kitchen, in town, cemetery, in transit, elsewhere.

2.3.6. Duration and intensity of crying

Participants recorded the estimated duration of the crying episode in minutes. Intensity was rated on a 4-point scale (1 = moist eyes, 2 = softy sobbing, 3 = loud crying, 4 = screaming and body movements).

2.3.7. Mood change after crying

Participants reported on how they felt after crying relative to how they felt before crying on a 3-point scale (−1 = worse, 0 = same, 1 = better).

2.4. Statistical analyses

First, bivariate correlations were used to test Hypotheses 1 and 2, which considered the overall relationship between dispositional mood, mood variability, urge to crying, and crying frequency.

To examine the influence of both individual-level and day-level predictors, multilevel regression analyses were conducted with all predictors in the same model. Given that the data have a clear hierarchical structure with days and crying episodes nested within subjects, multilevel regression analyses based on a random intercept model were carried out. By allowing the intercept of the regression equations to randomly vary over the subjects, the dependency of the observations among days and crying episodes within subjects is taken into account. The analyses were carried out with the mixed models procedure available in SPSS 17.0. In order to enable conditional log likelihood ratio tests in comparing different models, maximum likelihood was chosen as the estimation method.

To further test Hypothesis 2, multilevel analyses were conducted to examine the relationship between crying and daily mood on preceding and subsequent days (2 days prior and 2 days following a crying day). Separate analyses were conducted with daily average positive mood and daily average negative mood as the dependent variables and crying (dummy coded as 1 = crying day, 0 = non-crying day) as an uncentered level-1 predictor. To control for trait-level differences in mood, dispositional positive mood and dispositional negative mood were also added to the model (grand mean centered) as a level-2 predictor of both the participant's mood and the interaction of crying on mood.

In the multilevel analyses examining predictors of mood improvement (to test Hypotheses 3–6), the dependent variable was mood improvement, and the following explanatory variables were included in the analysis (uncentered) as level-1 predictors:

situation improvement, one other individual present during crying, multiple other individuals present during crying, duration of crying, intensity of crying, reasons for crying, and location of crying. To assess the effects of a single person being present, two dummy-coded variables (no other persons present and multiple other persons present) were created. For the seven reasons for crying, six dummy variables were created for the first six categories, and the last category (combination/other cause) was used as the reference category such that people who reported a combination of causes or other cause received a score of zero on all six dummy variables. For the eight locations of crying, seven dummy variables were created for the first seven categories, and the last category (elsewhere) was used as the reference category. For the reported number of individuals present, three dummy-coded variables were created to indicate whether the person cried alone, with one other individual present, or with multiple other individuals present. Finally, preliminary analyses revealed that the location of crying was not related to reported mood improvement; therefore, these variables are not considered further in the reported regressions.

3. Results

To provide a context for understanding the data presented in the primary analyses, we first report descriptive information on participants' crying episodes. The data consisted of mood reports from 97 subjects on 5381 different days (approximately 2 months per subject). Crying occurred on average for 16.41% of days recorded, ranging from 2% to 73% within individuals. A total of 1004 crying episodes were recorded on 883 different days (on some days the participants reported multiple crying episodes). The number of crying episodes per subject varied from 1 to 52 with an average value of 10.35, a median of 8.00 and a standard deviation of 8.73. There was no evidence of reactivity to the assessment, as crying frequency did not change across time (i.e., the proportion

Table 1
Overall means for mood and urge to cry.

Variable	Mean	SD
Urge to cry	2.37	.84
Ave pos mood	4.58	.67
Ave neg mood	2.56	.73
Daily pos mood MSSD	1.46	.82
Daily neg mood MSSD	1.03	.66
Daily pos mood on cry days	3.64	1.28
Daily neg mood on cry days	3.33	1.29
Daily pos mood on non-cry days	4.77	1.10
Daily neg mood on non-cry days	2.41	1.06

Note: MSSD = mean squared successive deviations.

Table 2
Correlations among overall means.

	Urge to cry	Prop of days cried	Ave neg mood	Ave pos mood	Neg mood MSSD	Pos mood MSSD
Urge to cry	–					
Prop of days cried	.458**	–				
Ave. neg mood	.733**	.280*	–			
Ave. pos mood	–.644**	–.312*	–.707**	–		
Neg mood MSSD	.340*	.149	.492**	–.390**	–	
Pos mood MSSD	.316*	.141	.291*	–.287*	.677**	–

Note: MSSD = mean squared successive deviations.

* $p < .01$.

** $p < .001$.

Table 3
Characteristics of crying episodes.

Variable	Frequency
<i>Reasons for crying:</i>	
Conflict	162 (16.1%)
Loss	135 (13.4%)
Personal failing	109 (10.9%)
Suffering of others	130 (13.1%)
Positive experience	61 (6.1%)
Physical experience	54 (5.4%)
Mental experience	113 (11.3%)
Combination/other	97 (9.7%)
<i>Social context:</i>	
Multiple persons present	196 (19.5%)
One other person present	396 (39.4%)
No other persons present	375 (37.4%)
<i>Location:</i>	
Living room	399 (39.7%)
Bedroom	284 (28.3%)
Kitchen	43 (4.3%)
Study room	5 (0.5%)
In town	15 (1.5%)
Cemetery	12 (1.2%)
In transit	10 (1.0%)
Other	176 (17.7%)
<i>Situation change:</i>	
Worsened	30 (3.0%)
Same	747 (74.4%)
Improved	214 (21.3%)
<i>Mood change:</i>	
Worsened	87 (8.8%)
Same	603 (60.8%)
Improved	302 (30.4%)
Variable	Mean (SD)
Duration of crying (min)	7.66 (13.34)
Intensity of crying	1.81 (.79)

for the first half of the days sampled did not significantly differ from the crying frequency in the second half of the days sampled).

The reported duration of crying varied from 30 s to 150 min with an average of 8 min, and most reported a crying intensity of moist eyes (39.7%) to soft sobbing (42.1%). The most common locations of crying were the living room (40.1%) or bedroom (28.6%), typically alone (37.9%) or with one other individual present (39.8%). The most common reasons for crying were conflict (16.3%), loss (13.5%) or witnessing the suffering of others (13.1%). Most reported no change in the situation that caused the crying (75.4%). Table 1 provides descriptive statistics for the crying and mood variables, and the correlations among these variables are presented in Table 2. Descriptive statistics for the context variables used in the regression analyses are presented in Table 3.

3.1. Crying, individual mood characteristics, and mood changes associated with crying

3.1.1. Crying and dispositional mood

Overall urge to cry, dispositional positive mood, dispositional negative mood, daily positive mood MSSD, and daily negative mood MSSD are reported in Table 1. Variables were first computed within individuals before computing grand averages. Consistent with Hypothesis 1, higher dispositional negative mood and lower dispositional positive mood were both associated with a greater proportion of crying days, indicating that individuals who cried more frequently had poorer overall mood over the entire study. As one might expect, proportion of days cried and urge to cry were highly positively correlated. Higher urge to cry was also related to higher dispositional negative mood and lower dispositional positive mood. In addition, urge to cry was positively correlated with both daily positive and negative mood variability, with individuals reporting more variable mood reporting stronger urges to cry. Since mood and mood variability measures are themselves often correlated (e.g., Eid & Diener, 1999), and were correlated in our dataset, we examined the relationship between mood variability and urge to cry, controlling for dispositional positive and negative mood (using a partial correlation). In this analyses, neither negative mood variability nor positive mood variability remained significantly associated with urge to cry (both $ps > .1$), which suggests that the relationship between mood instability and urge to cry is better accounted for by levels of dispositional mood.

3.1.2. Crying and daily mood

To examine how crying relates to mood in the days leading up to a crying episode and the days following a crying episode (Hypothesis 2), we conducted multilevel within-person analyses with crying as a predictor of daily positive and negative mood on the day of crying and the two days prior to and following a crying or non-crying day. The analyses also controlled for dispositional mood by including the dispositional positive mood and dispositional negative mood variables (overall average mood across days).

Multilevel analyses revealed that crying was related to higher daily negative mood ($t = 14.30, p < .0001$) and lower daily positive mood ($t = -19.47, p < .0001$) on crying days relative to non-crying days. The strong day-of-crying effects are depicted clearly in Fig. 1. Crying was related to higher negative mood in each of the two days preceding crying (2 days before: $t = 2.32, p < .05$; 1 day before: $t = 2.92, p < .01$) as well as to each of the two days following a crying episode (1 day after: $t = 4.48, p < .0001$; two days after: $t = 2.04, p < .05$), relative to other days. Crying was related to lower positive mood the day immediately before crying ($t = -2.13, p < .05$) and the day immediately after crying ($t = -4.64, p < .0001$), but did not predict positive mood two days before or two days following crying, suggesting a more transient relationship between positive mood and crying. Although we lack the temporal resolution to say whether the increased negative mood reported on the day of crying reflects poorer mood in the hours before, during, or after the crying episode, the results of analyses of the days preceding and following crying suggest that emotional tears were generally

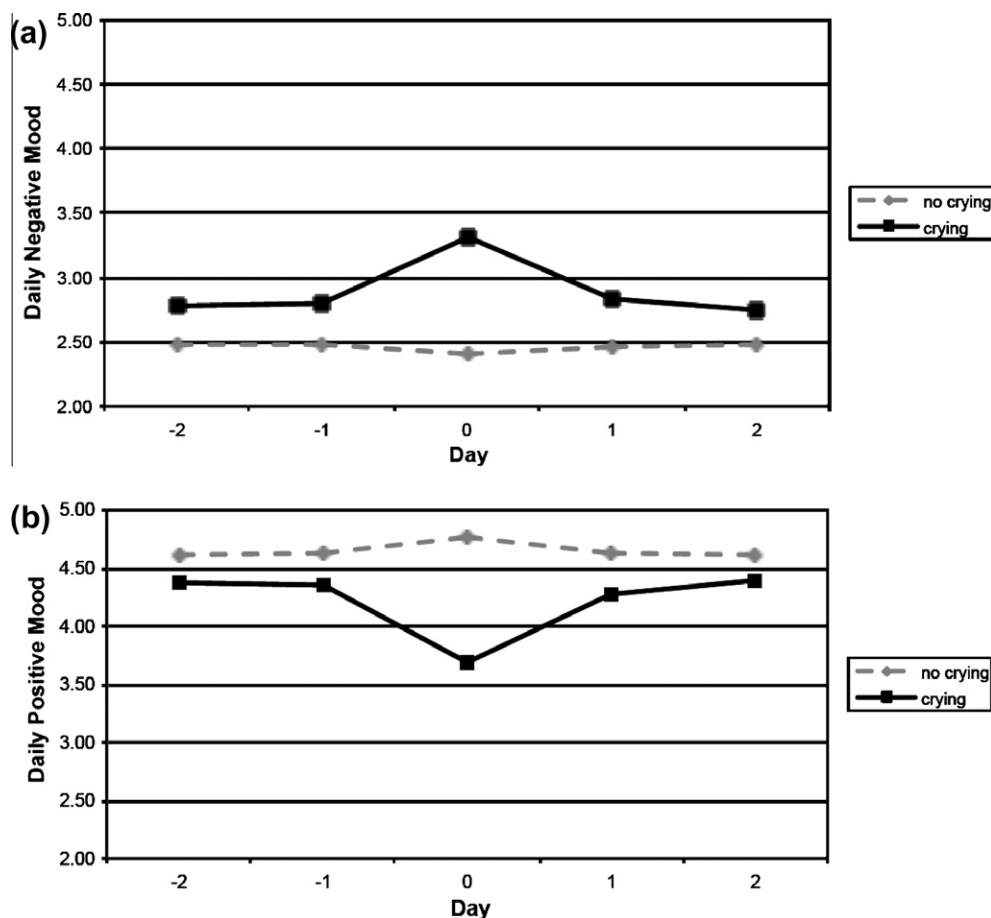


Fig. 1. Mean positive mood and negative mood for crying and days and the days preceding and following crying. Day 0 is the day of crying, -2 and -1 represent 2 and 1 days preceding the day of crying and 1 and 2 represent 1 and 2 days following the crying day. For individuals with multiple crying episodes, averages were first computed within-individual before computing grand averages.

Table 4
Results of multilevel regression (random intercept model) examining predictors of mood improvement after crying.

Parameter	Parameter estimate	SE	t
Intercept	.036	.047	.771
<i>Reasons for crying:</i>			
Conflict	-.165	.042	-3.971***
Loss	-.013	.046	-.286
Personal failing	.133	.046	2.800**
Suffering of others	-.107	.045	-2.373*
Positive experience	.157	.061	2.577*
Physical experience	-.032	.064	-.497
Mental experience	.027	.047	.574
Duration of crying	-.002	.001	-1.202
Intensity of crying	.064	.023	2.610**
<i>Social context:</i>			
Multiple persons present	-.054	.023	-2.334*
One other person present	.054	.023	2.335*
Situation improved	.522	.037	13.953***
<i>Covariance parameters</i>			
Residual	.255	.012	21.199***
Intercept variance	.015	.006	2.382*

Fixed by the analysis.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

preceded and followed by a period of worsened mood, and no apparent residual benefits.

3.1.3. Mood change after crying

For the majority of the crying episodes, participants reported no change in their mood relative to how they felt before crying (60.8%). However, mood improvement was reported for about one-third of the episodes (30.4%), while mood worsening occurred for 8.8% of episodes.

Consistent with Hypothesis 2 that a worse mood on the day of crying would predict less reported mood improvement after crying, mood improvement was inversely related to negative mood on the day of crying, as well as the days before and after (day before crying: $r = -.07$, $p = .03$; day of crying: $r = -.12$, $p < .001$; day after crying: $r = -.13$, $p < .001$). In other words, those women who reported more overall negative mood the day before, the day of, and the day after a crying episode, tended to report less mood improvement after crying. The effects for positive mood were not significant.

Crying duration and intensity were included as exploratory predictors of post-crying mood. Duration of reported crying was not associated with post-crying mood improvement. In contrast, intensity of crying was positively associated with mood improvement, such that more intense crying was associated with greater post-crying mood improvement (Table 4).

3.2. The impact of social context and crying triggers on mood changes

To examine the impact of social context and crying triggers on mood changes following crying, we conducted a series of multilevel regression analyses. The full results of the multilevel regressions are presented in Table 4.

3.2.1. Social context of crying and situation change

Based on previous findings, we predicted that the presence of one other individual would be associated with the greatest post-crying mood improvement. Consistent with predictions of Hypothesis 4, having one other person present was found to be positively associated with mood improvement after crying, while having

multiple individuals present or crying alone were negatively associated with mood improvement relative to crying alone. Consistent with Hypothesis 5, experiencing an improvement or resolution to the situation that triggered the crying was associated with mood improvement (see Table 4).

3.2.2. Crying triggers

Based on previous findings, we predicted that the experience of a positive event (Hypothesis 5) would be related to greater mood improvement after crying, while witnessing suffering (Hypothesis 6) would be negatively related to mood improvement after crying. As shown in Table 4, these relationships were supported by the data.

3.2.3. Analyses of social context controlling for daily positive and negative mood

Finally, we conducted follow-up analyses to examine whether our social context findings might be better explained by mood. This was accomplished repeating multilevel regression analyses, this time adding daily positive and negative mood to the model as predictors. Importantly, the overall patterns of results remained the same. All eight social context variables that were significant in Table 4 remained significant predictors of mood improvement after crying, even after accounting for mood on the day of crying. In other words, there was no evidence that social context findings were better explained by mood.

4. Discussion

Tearful crying is among the most dramatic and unique human behaviors, yet we still have little systematic knowledge about it. Although the scientific and popular literature commonly states that crying is psychologically beneficial, most studies of crying and mood change have been hampered by significant methodological limitations. We used an extended daily diary design with the goal of repeatedly sampling of crying episodes from everyday life. Consistent with this goal, we obtained 1004 reports of crying episodes from 97 individuals. Our study design provided an opportunity to comprehensively examine mood and crying, with mood analyzed both as a predictor of crying and as an outcome of crying, guided by our heuristic framework for understanding variations in adult crying, which included both intrapersonal and interpersonal factors (Rottenberg, Bylsma & Vingerhoets, 2008). Consistent with our approach, we found that crying and the reported benefits of crying, when they occur, are shaped by the affective characteristics of the crier and by the social context in which crying occurs.

As expected, dispositional mood states – the average mood level assessed over many daily assessments – predicted how often people reported crying. Specifically, higher dispositional negative mood and lower dispositional positive mood were associated with more frequent crying and higher reported urge to cry. This result is consistent with previous findings that neuroticism (De Fruyt, 1997; Peter et al., 2001) and depression (Rottenberg, Cavaal & Vingerhoets, 2008) both are associated with more frequent crying, and that sadness is the most common antecedent of crying in healthy individuals (Vingerhoets, van Geleuken, van Tilburg, & van Heck, 1997).

In addition, a higher overall urge to cry was associated with greater positive and negative mood day-to-day variability. This finding is of keen theoretical interest because greater mood variability, generally, has been associated with disorders of emotion regulation, including anxiety (Bowen, Baetz, Hawkes, & Bowen, 2006), substance abuse (Bowen, Block, & Baetz, 2008), depression (Peeters, Berkhof, Delespaul, Rottenberg, & Nicolson, 2006), and borderline personality disorder (Trull et al., 2008) as well as

neuroticism, an individual difference variable characterized by affective instability (e.g., Kuppens, van Mechelen, Nezlek, Dossche, & Timmermans, 2007). At the same time, we must be cautious in interpreting this effect because it did not survive covariation for dispositional mood.

Overall, we observed very little evidence of psychological benefits associated with crying. Not only was mood more negative on the day of crying than on non-crying days, the results of analyses of the days preceding and following crying suggested that emotional tears were generally preceded and followed by a period of worsened mood, with no apparent residual benefits. We further demonstrated that, within individuals, mood on the day of a crying episode was worse relative to non-crying days. Finally, only about 30 percent of crying episodes, a distinct minority, were associated with reported mood improvement. Taken together, these findings demonstrate, now with a stronger daily diary design, that the purported psychological benefits of crying are much less robust when people are asked to reflect upon specific crying episodes than when they are asked about their crying in general. Especially if the results are replicated in future work, these data pose a strong challenge to universal theories of crying that posit its core function as providing benefits to the crier (e.g., Efran & Spangler, 1979; Miceli & Castelfranchi, 2003).

Our strong day-of-crying mood effects were particularly notable. One caveat about this result is that we cannot comment on the precise timing of this mood effect given that participants gave only one end-day report of overall mood that covered the entire crying day. Worse mood on the day of crying could reflect the period right before, during, or right after crying. One possibility is that the worse mood on the day of crying may in part reflect the experience of a negative event on that day. However, inconsistent with this explanation, our multilevel modeling analyses also revealed that crying was also associated with worsened mood on days preceding the crying episode.

We also examined intrapersonal and social factors that explain when crying might be beneficial. Although the extent of positive mood states was unrelated to reported benefits from crying, being in a negative mood was consistently associated with fewer mood benefits of crying. Women who reported a more overall negative mood the day before, the day of, and the day after a crying episode, were less to report mood benefits after crying. These results are consistent with earlier results showing depression to be associated with reduced experience of post-crying mood benefits (Rottenberg, Bylsma & Vingerhoets, 2008; Rottenberg, Cevaal & Vingerhoets, 2008).

Interestingly, we found that those who cried with greater intensity (but not duration) were more likely to experience mood benefits from crying. This effect has not been observed in previous studies examining predictors of the mood benefits of crying. It may be that reports of crying intensity are more accurate in the daily diary design in comparison to retrospective self-report designs where individuals often reported on crying episodes that occurred weeks or even months earlier or in comparison to laboratory studies where the duration and intensity of crying are generally very restricted in range. It is unclear why greater crying intensity might result in greater mood benefits. Perhaps more intense crying may be more likely to attract social support.

Importantly, the antecedent context of crying also predicted when crying was beneficial, and did so independently of daily mood. Specifically, witnessing the suffering of others as a reason for crying was negatively associated with mood improvement, while the experience of a positive event or a personal inadequacy and experiencing a positive change in the situation that caused crying were all associated with positive post-crying mood improvement (Bylsma et al., 2008). That conflict was associated with worse post-crying mood runs counter to the idea that crying

may prevent escalation of conflicts and that tears are powerful means to reduce aggression (e.g., Hasson, 2009; Shaver, Schwartz, Kirson, & O'Connor, 1987). Consistent with the emphasis of our heuristic framework (Rottenberg, Bylsma & Vingerhoets, 2008), one common thread in these findings is that situations in which an individual has more control over or where the support of others may be more beneficial (i.e., personal inadequacy) are more likely to result in mood improvement, relative to situations where the individual has less control (i.e., witnessing suffering, conflict), due to crying inducing a change in the situation or better understanding of the reason for crying (Bylsma et al., 2008). These findings have added credibility because the antecedents and contextual features that predicted mood benefits from crying in a retrospective design (Bylsma et al., 2008; Rottenberg, Bylsma, Wolvin et al., 2008) replicated in this very different, and rigorous daily diary design.

Furthermore, we also found that specific features of the social environment also predicted when crying had beneficial mood effects. Individuals reported the most mood improvement in the presence of one other individual, and the least improvement in the presence of multiple other individuals relative to crying alone (Bylsma et al., 2008). These findings may reflect the benefits of social support during a crying episode in the presence of one individual, especially a close individual who is more likely to provide support. The presence of multiple individuals may induce shame or embarrassment about crying or attempts to suppress crying which may hinder the experience of the mood benefits of crying (Gross, 1989; Miceli & Castelfranchi, 2003). As in our previous work in a retrospective survey design (Bylsma et al., 2008), we did not find benefits associated with specific crying locations. Again, replication of results across very different methods lends the present findings added credibility.

4.1. Conclusions, limitations and future directions

These findings demonstrated that the affective consequences of crying are determined by affective conditions inside the crier, antecedent events, and the social reactions of others to crying. Taken together, our findings demonstrate the value of taking a multidomain approach to studying crying (Rottenberg et al., 2008). At the same time, we must respect that we remain at an early stage of knowledge. For example, we do not yet have adequate theory or data to begin to model the interactions between these key domains, and we did not do so here. Moreover, although we included multiple variables and domains, we did not attempt to include all possibly relevant variables within our chosen domains, and there is no doubt that the effects of crying are also shaped by other domains, such as the physiological changes set in motion by tear flow.

Perhaps the signal strength of this study was that the use of the daily diary format allowed us to examine reports of crying, its antecedents, and its effects in a relatively short period of time after the crying has occurred, reducing retrospective biases. As important, we obtained a sample of days that was sufficiently large so that all individuals cried at least once, and for many individuals multiple crying episodes were reported, allowing the use of multilevel modeling to examine within-individual effects. This was also the first study to examine the relationship between mood levels and variability, on the one hand, and urge to cry, crying frequency, mood after crying, and longer-term affective patterns on the other hand. In these respects, the results afforded a more comprehensive examination of the relationship between crying and mood as well as the impact of situation and context on crying and mood change.

It is also important to acknowledge the study limitations. First, daily reports minimized retrospective bias, but could not eliminate it entirely. Second, while compliance appears to have been

excellent, the data collection used paper-and-pencil diaries, which means that completions were not stamped with the time and day that reports were actually completed. This limitation could be addressed in the future using a computerized experience sampling method (ESM) design. Indeed, we believe that such ESM designs would be a critical future direction to extend the present results. One critical issue will be to optimize an ESM recording protocol so it is of a sufficiently long duration and sampling density to record multiple crying episodes as they unfold without it being prohibitively high in participant burden. Third, given that women cry more frequently relative to men (e.g., Vingerhoets & Scheirs, 2000), and we wanted to ensure that an adequate number of crying episodes would be obtained, this sample consisted of females only. Thus one future direction is to examining the generalizability of our findings to males. Finally, as a secondary analysis of pre-existing data we were also limited by our measure of mood improvement after crying which was recorded on only a 3-point scale, and which may have constrained our ability to detect small effects. Despite the less than optimal nature of this scale, we found many interpretable effects that were consistent with findings from a larger international dataset (Bylsma et al., 2008) and the Frey and colleagues (1983) report on a different culture and age group. Even granted these limitations, this study was the first extended examination of the relationship between crying and mood using detailed contextual information from multiple crying episodes, and, as such, represents an important step towards understanding this striking human behavior.

Acknowledgment

The authors are indebted to Lisanne Huis in 't Veld for her assistance with data entry and management.

References

- Bindra, D. (1972). Weeping: A problem of many facets. *Bulletin of the British Psychological Society*, 25, 281–284.
- Bolger, N., Davis, A., & Rafaeli, E. (2003). Diary methods: Capturing life as it is lived. *Annual Review of Psychology*, 54, 579–616.
- Bowen, R., Baetz, M., Hawkes, J., & Bowen, A. (2006). Mood variability in anxiety disorders. *Journal of Affective Disorders*, 91, 165–170.
- Bowen, R., Block, G., & Baetz, M. (2008). Mood and attention variability in women with alcohol dependence. A preliminary investigation. *The American Journal on Addictions*, 17, 77–81.
- Breuer, J., & Freud, S. (1895/1968). *Studies on hysteria*. London: Hogarth Press.
- Bylsma, L. M., Vingerhoets, A. J. J. M., & Rottenberg, J. (2008). When is crying cathartic?: An international study. *Journal of Social and Clinical Psychology*, 27, 1080–1102.
- Cornelius, R. R. (1986). Prescience in the pre-scientific study of weeping? In A history of weeping in the popular press from the mid-1800's to the present" presented at the 57th annual meeting of the psychological association. New York.
- Cornelius, R. R. (1997). Toward a new understanding of weeping and catharsis? In A. J. J. M. Vingerhoets, F. J. van Bussel, & A. J. W. Boelhouwer (Eds.), *The (non)expression of emotions in health and disease* (pp. 30–32). Tilburg, The Netherlands: Tilburg University Press.
- De Fruyt, F. (1997). Gender and individual differences in adult crying. *Personality and Individual Differences*, 22, 937–940.
- Efran, J. S., & Spangler, T. J. (1979). Why grown-ups cry: A two-factor theory and evidence from "The Miracle Worker". *Motivation and Emotion*, 3, 63–72.
- Eid, M., & Diener, E. (1999). Intraindividual variability in affect: Reliability, validity, and personality correlates. *Journal of Personality and Social Psychology*, 76, 662–676.
- Frey, W. H., Hoffman-Ahern, C., Johnson, R. A., Lykken, D. T., & Tuason, V. B. (1983). Crying behavior in the human adult. *Integrative Psychiatry*, 1, 94–100.
- Gross, J. J. (1989). Emotional expression in cancer onset and progression. *Social Science and Medicine*, 12, 1239–1248.
- Gross, J. J., Fredrickson, B. L., & Levenson, R. W. (1994). The psychophysiology of crying. *Psychophysiology*, 31, 460–468.
- Hasson, O. (2009). Emotional tears as biological signals. *Evolutionary Psychology*, 7, 363–370.
- Heilbrunn, G. (1955). On weeping. *The Psychoanalytic Quarterly*, 24, 245–255.
- Jahng, S., Wood, P. K., & Trull, T. J. (2008). Analysis of affective instability in ecological momentary assessment: Indices using successive difference and group comparison via multilevel modeling. *Psychological Methods*, 4, 354–375.
- Kottler, J., & Montgomery, M. J. (2001). Theories of crying. In A. J. J. M. Vingerhoets & R. R. Cornelius (Eds.), *Adult crying: A biopsychosocial approach* (pp. 1–17). Hove, UK: Brunner-Routledge.
- Kraemer, D. L., & Hastrup, J. L. (1986). Crying in natural settings: global estimates, self-monitored frequencies, depression and sex differences in an undergraduate population. *Behavior Research and Therapy*, 24, 371–373.
- Kuppens, P., van Mechelen, I., Nezlek, J. B., Dossche, D., & Timmermans, T. (2007). Individual differences in core affect variability and their relationship to personality and adjustment. *Emotion*, 7, 262–274.
- Labott, S. M., & Martin, R. B. (1987). The stress-moderating effects of weeping and humor. *Journal of Human Stress*, 13, 159–164.
- Lombardo, W. K., Cretser, G. A., Lombardo, B., & Mathis, S. L. (1983). Fer cryin' out loud—there is a sex difference. *Sex Roles*, 9, 987–995.
- Martin, R. B., & Labott, S. M. (1991). Mood following emotional crying: Effects of the situation. *Journal of Research in Personality*, 25, 218–244.
- Miceli, M., & Castelfranchi, C. (2003). Crying: Discussing its basic reasons and uses. *New Ideas in Psychology*, 21, 247–273.
- Nelson, J. K. (2005). *Seeing through tears: Crying and attachment*. New York: Brunner-Routledge.
- Nezlek, J. B. (2001). Multilevel random coefficient analyses of event- and interval-contingent data in social and personality psychology research. *Personality and Social Psychology Bulletin*, 27, 771–785.
- Nezlek, J. B. (2007). Multilevel modeling in research on personality. In R. Robins, R. C. Fraley, & R. Krueger (Eds.), *Handbook of Research Methods in Personality Psychology* (pp. 502–523). New York, NY: Guilford Press.
- Parkinson, B., Briner, R. B., Reynolds, S., & Totterdell, P. (1995). The frames for mood: Relations between momentary and generalized ratings of affect. *Personality and Social Psychology Bulletin*, 21, 331–339.
- Peeters, F., Berkhof, J., Delespaul, P., Rottenberg, J., & Nicolson, N. A. (2006). Diurnal mood variation in major depressive disorder. *Emotion*, 6, 383–391.
- Peter, M., Vingerhoets, A. J. J. M., & van Heck, G. L. (2001). Personality, gender, and crying. *European Journal of Personality*, 15, 19–28.
- Poikolainen, K., & Karikkainen, P. (1983). Diary gives more accurate information about alcohol consumption than questionnaire. *Drug and Alcohol Dependence*, 11, 209–216.
- Rottenberg, J., Bylsma, L. M., & Vingerhoets, A. J. J. M. (2008). Is crying beneficial? *Current Directions in Psychological Science*, 17, 400–404.
- Rottenberg, J., Bylsma, L. M., Wolvin, V., & Vingerhoets, A. J. J. M. (2008). Tears of sorrow, tears of joy: An individual differences approach to crying. *Personality and Individual Differences*, 45, 367–371.
- Rottenberg, J., Cevaal, A., & Vingerhoets, A. J. J. M. (2008). Do mood disorders alter crying? A pilot investigation. *Depression and Anxiety*, 25, E9–E15.
- Rottenberg, J., Gross, J. J., Wilhelm, F. H., Najmi, S., & Gotlib, I. H. (2002). Crying threshold and intensity in major depressive disorder. *Journal of Abnormal Psychology*, 111, 302–312.
- Sadoff, R. L. (1966). On the nature of crying and weeping. *Psychiatric Quarterly*, 40, 490–503.
- Scheff, T. (1979). *Catharsis in healing, ritual, and drama*. Berkeley, CA: University of California Press.
- Scheff, T., & Buschnell, D. (1984). A theory of catharsis. *Journal of Research in Personality*, 18, 238–264.
- Shaver, P., Schwartz, J., Kirson, D., & O'Connor, C. (1987). Emotion knowledge: Further explorations of a prototype approach. *Journal of Personality and Social Psychology*, 52, 1061–1086.
- Trull, T. J., Solhan, M. B., Tragesser, S. L., Jahng, S., Wood, P. K., Piasecki, T. M., et al. (2008). Affective instability: Measuring a core feature of borderline personality disorder with ecological momentary assessment. *Journal of Abnormal Psychology*, 117, 647–661.
- van Tilburg, M. A. L., Becht, M. C., & Vingerhoets, A. J. J. M. (2003). Self-reported crying during the menstrual cycle: Sign of discomfort and emotional turmoil or erroneous beliefs? *Journal of Psychosomatic Obstetric Gynecology*, 247, 255.
- Vingerhoets, A. J. J. M. (1995). *The ISAC questionnaire*. The Netherlands: Department of Psychology, Tilburg University.
- Vingerhoets, A. J. J. M., Bylsma, L., & Rottenberg, J. (2009). Crying: A biopsychosocial phenomenon. In T. Fögen (Ed.), *Tears in the Graeco-Roman world* (pp. 439–475). Berlin & New York: de Gruyter.
- Vingerhoets, A. J. J. M., Rottenberg, J., Cevaal, A., & Nelson, J. K. (2007). Is there a relationship between depression and crying? A review. *Acta Psychiatrica Scandinavica*, 115, 340–351.
- Vingerhoets, A. J. J. M., & Scheirs, J. G. M. (2000). Sex differences in crying: Empirical findings and possible explanations. In A. H. Fischer (Ed.), *Gender and emotion: Social psychological perspectives* (pp. 143–165). Cambridge: Cambridge University Press.
- Vingerhoets, A. J. J. M., van Geleuken, A. J. M. L., van Tilburg, M. A. L., & van Heck, G. L. (1997). The psychological context of crying: Towards a model of adult crying. In A. J. J. M. Vingerhoets, F. J. Van Bussel, & A. J. W. Boelhouwer (Eds.), *The (non)expression of emotions in health and disease* (pp. 323–336). Tilburg, The Netherlands: Tilburg University Press.