Why only humans shed emotional tears

Gracanin, A.; Bylsma, L.M.; Vingerhoets, A.J.J.M.

Published in:
Human Nature

DOI:
10.1007%2Fs12110-018-9312-8

Publication date:
2018

Document Version
Publisher's PDF, also known as Version of record

Hum Nat (2018) 29:104–133
https://doi.org/10.1007/s12110-018-9312-8

Why Only Humans Shed Emotional Tears

Evolutionary and Cultural Perspectives

Asmir Gračanin[1,2,3] **· Lauren M. Bylsma**[4] **·**
Ad J. J. M. Vingerhoets[1]

Published online: 20 March 2018

Abstract Producing emotional tears is a universal and uniquely human behavior. Until recently, tears have received little serious attention from scientists. Here, we summarize recent theoretical developments and research findings. The evolutionary approach offers a solid ground for the analysis of the functions of tears. This is especially the case for infant crying, which we address in the first part of this contribution. We further elaborate on the antecedents and (intra- and interpersonal) functions of emotional tears in adults. The main hypothesis that emerges from this overview is that crying evolved as an emotional expression that signals distress and promotes prosocial behaviors in conspecifics. Further, shedding tears may influence the mood of the crier and his/her outlook on life primarily as a consequence of fulfillment of the proposed signaling function of tears. We also describe how cultural phenomena such as ritual weeping nicely fit within this framework, as they often aim to support a request for help to a powerful person or deity and promote social bonding.

Keywords Tears · Infant crying · Weeping · Evolution · Psychology · Social bonding

Tears have fascinated humanity since antiquity. At different times, they have been addressed in poetry, literature, and religious writings. For centuries, various scholars have considered intriguing questions regarding emotional crying, such as where tears originate from (the heart or the brain?), how individual and gender differences in crying should be explained, the connection with personal characteristics (e.g., sincerity,

✉ Asmir Gračanin
agracanin@ffri.hr

[1] Department of Medical and Clinical Psychology, Tilburg University, Tilburg, The Netherlands

[2] Tilburg Center for Cognition and Communication, Tilburg University, Tilburg, The Netherlands

[3] Department of Psychology, University of Rijeka, Sveučilišna avenija 4, 51000 Rijeka, Croatia

[4] Department of Psychiatry, University of Pittsburgh, Bradford, USA

goodness, and being in love), why crying brings relief (Petitus 1661, in Horstmanshoff 2014), and whether only humans have the capacity to shed emotional tears (Vingerhoets 2013). Darwin (1872) was the first to discuss tearful crying in a more modern, scientific way in his seminal work *The Expression of Emotions in Man and Animals*. He connected emotional tears not only to suffering and distress but also to tender feelings. Darwin further addressed some important developmental aspects of tearful crying and even devoted attention to cross-cultural issues. However, his surprising conclusion with respect to the function of tears was that "We must look at weeping (i.e., the production of emotional tears) as an incidental result, as purposeless as the secretion of tears from a blow outside the eye, or as a sneeze from the retina being affected by a bright light" (Darwin 1872:175). This was in sharp contrast to his appraisal of basal (i.e., non-emotional) tears, which, he acknowledged, serve important functions such as lubrication, nourishment, and protection of the eye, and of the vocal crying of infants, which, he was aware, solicits the attention of caregivers. Consequently, Darwin did not speculate about evolutionary functions of emotional tears. Possibly as a consequence of Darwin's claims, the next century was marked by a striking contrast between the great interest of lay people in this topic, on the one hand, and the absence of efforts to unravel this phenomenon on the part of researchers, on the other (see also Vingerhoets and Bylsma 2016).

In the present review, we summarize what modern research in this nascent field has yielded, and we present new theoretical insights into the functions of emotional tears. We begin with a description of some important ontogenetic and phylogenetic aspects of tearful crying, which is accompanied by a discussion about the evolved signaling functions of tears. Proposed functional accounts are then evaluated in an overview of what makes us cry, including the role of context, as well as recent research on the effects of tears on the criers themselves, and on observers. Finally, we discuss some relevant anthropological phenomena—in particular, ritual weeping. To conclude, we highlight how the study of emotional tears can deepen our understanding of human social and moral behavior. First, however, as a necessary element of the functional analysis of tearful crying, we address the question of whether humans are in fact the only species producing emotional tears.

Do Only Humans Produce Emotional Tears?

As mentioned above, as early as the Renaissance there was already discussion of whether animals, but also creatures such as witches, werewolves, and vampires as well as angels and humans in the afterlife, were able to shed emotional tears. The capacity to produce emotional tears was even part of a test to determine if someone was a real human or perhaps a witch or werewolf (Ebersole 2000; Vingerhoets 2013). Irrespective of how futile they may often seem, these considerations nicely illustrate the early, pre-scientific awareness of tearful crying as a behavior that distinguishes humans from other beings (whether real or fantasy creatures).

Although there seems to be a consensus among contemporary scientists that weeping is uniquely human, there have been ample anecdotal descriptions of weeping animals (cf. Masson and McCarthy 1995; Vingerhoets 2013). For example, Homer described how a horse expressed its loyalty to its master, Patroclus, by weeping over his

death. Also, crocodiles reportedly shed tears, initially not the proverbial (and hypocritical) crocodile tears, but rather to express real suffering when being physically abused (Vingerhoets 2013). Deer also were said to weep after having shed their horns (Treacher-Collins 1932). Even Darwin (1872) discussed some observations of weeping animals, including macaques and, in particular, elephants. According to Reynolds (1924), weeping is a typical reaction of certain animals (particularly wolves) that signals exhaustion, which results in the tearful animal being placed at the rear of the pack to allow it to rest and recover. Further, Fossey (2000) described how Coco, a gorilla, wept when he was ill. Finally, in the documentary film *The Weeping Camel* (Davaa and Falorni 2003), the camel mother starts to produce tears at the moment that she reconnects with her previously rejected offspring and allows it to nurse.

However, the only more systematic study on this topic, a survey among people who work with animals professionally, including veterinarians and zookeepers failed to yield even a single observation of a weeping animal (Frey 1985). Murube (2009a) also concludes that animals generally do not produce emotional tears, although he admitted that several anecdotal reports deserve serious attention by investigators. Consequently, we must conclude that we currently do not have sufficient evidence to document weeping in nonhuman animals. If it does occur, it is extremely exceptional. The apparent uniqueness of human weeping suggests that tears might represent a functional response to adaptive challenges specific to the hominid lineage, which is crucial for understanding both the evolved functions and the proximate mechanisms of this complex behavior.

The Ontogenetic Development of Emotional Tears

In order to obtain an adequate understanding of the potential functions of crying over the lifespan, it is crucial to start our analysis by focusing on infant crying. In addition to simply being more systematic, the rationale for this strategy is based on the usefulness of the comparative approach in the functional analysis of behavior. Note that the behavior observed in species other than humans that is most comparable to human tearful crying is the *distress (or separation) call,* which is uttered almost exclusively by infant mammals and birds and not by adults (with dogs as a notable exception, among a few others). Relatedly, human emotional crying is thought to have its evolutionary origins in the acoustical distress calls of animals (Newman 2007). It is also important to note that in animals (and in human infants in the first weeks of their lives), crying is a purely vocal signal, and later, whereas it mostly disappears in adult animals, in humans it becomes coupled with the production of tears (Penbharkkul and Karelitz 1962). In addition, there is suggestive evidence that the same neural mechanisms are involved in distress vocalizations of many mammalian species and that all primates share the same developmental course of vocal crying. Both findings suggest that the distress vocalizations (specifically in response to separation) arose early in (primate) evolution and remained largely unchanged, or that there has been a high degree of convergent evolution toward this behavior, which must have been highly adaptive in a variety of habitats and social settings (Newman 2007).

Although there are several important parallels between human adult crying and infant crying, there are also some major developments that take place over the lifespan.

More specifically, with advancing age the following developments occur: (1) a decrease in the frequency of (acoustical) crying; (2) a seemingly increasing importance of producing visible tears in comparison to vocal crying; (3) the emergence of the gender differential in crying; and, finally, (4) some major changes in the antecedents of crying (Rottenberg and Vingerhoets 2012). The ontogenetic development of crying in humans thus runs from merely acoustical crying (without tears) to predominantly producing tears (a purely visual signal, with typically only minimal vocal accompaniment, except for, occasionally, some intense sobbing). Since gender differences received adequate attention in previous articles (e.g., Vingerhoets 2013; Bekker and Vingerhoets 1999, 2001; Vingerhoets and Scheirs 2000), the focus here will be on the other issues, after a summary of what is currently known about infant crying.

Infant Crying

Human infants are among the most powerless and helpless creatures in the animal kingdom, and they maintain that state for quite a long period, during which they are to a great extent dependent on their caregivers. Unlike other primates, they cannot cling to their mothers' fur, and neither are their motor skills sufficiently developed to follow their mothers, unlike, for example, the offspring of geese and ducks. Their behavioral repertoire is thus mainly limited to satisfying their physiological needs (eating, sleeping, eliminating waste, smiling, and vocal crying). Their additional "equipment" is their physical appearance, the typical characteristics of their head and eyes that automatically trigger a caregiving response in adults (the Baby Scheme Effect; Glocker et al. 2009a, 2009b).

As mentioned above, and similar to most birds and mammals, human newborns also produce distress or separation calls when they are separated from the mother. Additional frequent triggers are pain and physical discomfort (e.g., cold, hunger) and the lack of (maternal) attention. Mothers are particularly good at recognizing their own child's cry and can distinguish between cries associated with the different triggers, and they react substantially more quickly to pain cries than to cries that convey a lesser degree of discomfort (Soltis 2004). The great majority of infants initiate crying when put down and discontinue when picked up. Consequently, infant crying has been considered an attachment behavior (Bowlby 1969, 1980) triggered mainly by physical separation—hence the labeling of infant crying as "the acoustical umbilical cord" (Ostwald 1972). As has been observed especially in nonindustrialized societies, human infants hardly, if ever, cry when they are carried in a sling and have continuous physical contact with their mother (Barr 1999). This is also characteristic for the infant distress vocalizations in other species, which further supports the attachment theorists' (e.g., Bowlby 1969) claims that one of the most important functions of infant crying is the maintenance of proximity between the infant and the caregiver. In addition to representing a functional response to these external causes, infant crying may promote the regulation of physiological homeostasis—for example, by discharging excess energy and tension or as the consequence of normal maturation processes in the central nervous system (Zeifman 2001). It is, however, not easy to demonstrate the validity of these postulated internal causes. We only know that, over a variety of cultures and independent of caregiving practices, as well as among chimpanzee infants, vocal crying

is displayed most frequently at the age of six weeks, which does suggest an internal cause such as central nervous system development (Zeifman 2001).

Possible functions of infant crying are aptly summarized by Lummaa et al. (1998), who proposed four non-mutually-exclusive hypotheses that might explain the benefits of intense infant crying. The first hypothesis emphasizes that, as in other mammals and birds, crying acts as a separation call whose function is to reduce the risk of abandonment and losing physical contact with the mother. The second hypothesis stresses that crying is a reliable indicator of the vigor and fitness of the child and consequently might reduce the risk of infanticide during adverse ecological conditions. Specific characteristics of crying behavior convey important information about the infant's health status, which can both increase and decrease the fitness of the child. In particular, infant cries that substantially deviate from the norm are associated with a compromised health status (Furlow 1997; Soltis 2004). Research has further shown that preterm infants cry more frequently than their full-term age mates (Friedman et al. 1982) and that their crying is perceived as more aversive (Frodi et al. 1978). High- and variable-pitched crying seems to result in non-optimal parental responses and in ignoring the infant (Frodi and Senchak 1990), and mothers of premature infants more likely withdraw from a premature infant's cry rather than respond to it (Worchel and Allen 1997). On the other hand, the same hypothesis predicts that the vigorous crying of a healthy child can facilitate investment rather than withdrawal of parents' resources. The third hypothesis proposed by Lummaa et al. (1998) focuses on the capacity to utilize crying to manipulate or blackmail the parents with the increased risk of predation (because of the loud noise) or dangerous loss of energy, to make them exceed their optimal level of investment to the infant. Finally, in the "superchild" hypothesis, the central issue is that an exceptionally vigorous child can utilize its powerful signal to minimize the costs of sibling competition by making the parents delay the birth of a next sibling.

For a proper understanding of the functions of infant crying, one must keep in mind a precise definition of biological signals, and, in particular, how signals differ from cues. The latter refer to information that is not emitted with the purpose of benefiting the sender, although it certainly benefits the receiver (e.g., the behavior of wounded prey may inform predators about an easy target). However, a cue does not *necessarily* bring harm to its sender; rather, it is simply not designed to bring it any benefit. Signals, in contrast, are shaped by natural selection because they convey information which, on average, influences the behavior of others in a way that benefits both the sender and the receiver (Laidre and Johnstone 2013). Therefore, the prerequisite for information to be a signal is that the sender and the receiver share at least some common interest in relation to it. For example, a mother's own fitness can be increased when she appropriately responds to her infant's crying by feeding and thus increasing the fitness of the hungry infant. However, although it evolved as a signal, in some contexts, crying may also act as a cue to parents because, as noted above, there are some situations when the overlap of parents' and infants' interests is minimal. This may happen when special characteristics of crying, such as those reflecting a compromised health status and/or developmental problems, prevent the investment in that specific child. The behavior of which the original function was to act as a signal now acts as a cue because in this case it only serves the fitness of the caregiver.

All animal signals fit within one of several different types (Maynard Smith and Harper 2003), two of which we briefly discuss here. *Index* signals are characterized by an unambiguous link between the signal and the signaler's physical condition, and as such, they reliably indicate a certain quality of the signaler. As already discussed, in the newborns of different species, the physical properties of the distress or begging calls may also reflect the health status of the child, which, in turn, systematically influences parental resource allocation. For example, since only healthy infants can cry vigorously, parents can use the information of this type of signal to estimate the likelihood of an infant's survival. This, in turn, determines the amount of their investment in the infant, taking into account several other relevant variables (the presence of siblings, availability of resources, etc.). Note that, in contrast to the above-discussed decoding of cues of a child's underdevelopment, in this case the impact of more-vigorous crying benefits the infant. Such signals are also competitive in relation to present or future siblings (which corresponds to the "superchild hypothesis" of Lummaa et al. [1998]). In addition, needier infants are more likely to produce crying as a *general handicap* signal. Note that these signals are by themselves relatively costly for signalers. Signalers who are to benefit most from such signals are always those who are in greater need (e.g., a child that would benefit from being fed or held and kept warm); therefore, unreliable signaling of this type simply does not make sense. More precisely, vocal infant crying can be regarded as a reliable signal because of the associated costs both in metabolic rate and in the possibility of attracting predators. At the same time, it also conveys the infant's neediness and is efficient in eliciting caretaking behavior (for a review, see Wells 2003), which ultimately pays off more than when it is not reliable, since the gains of satisfying neediness are greater than the costs of producing the signal (see also Zahavi 1977). Moreover, for a behavior to be considered an evolved signal, it must be highly reliable because not just the senders but also the recipients of signals have their own evolutionary interests. Thus, as soon as signals become unreliable, recipients will gradually stop paying attention to them, which would again push signalers to adapt and produce more-reliable signals (for a mathematical model see Johnstone and Grafen 1992). This does not mean that signals are always reliable, but rather that they, on average, carry reliable information. Therefore, infant crying can most often be regarded as a reliable signal to the parent owing to the generally mutual inclusive fitness of the infant and the parent.

The next important question concerns the physical properties of the average infant crying signal. Why is it an acoustical signal, rather than a chemical (pheromones) or visual signal that plays a key role in mother-child communication? An obvious advantage of acoustical signals is that they can be heard at relatively long distances; they are effective during day and night, and also when there is dense vegetation or any other type of barrier. At the same time, the physical characteristics of infant crying (e.g., high pitch) prevent it from being heard at too far a distance (in comparison to low-frequency sounds), which limits the risk that it attracts predators. Finally, vocal signals can easily be turned on and off without leaving any traces, and they are conspicuous (Zeifman 2001). Vocal crying is transmitted in all directions and thus has a relatively wide (i.e., mid-range) reach, which is useful in case of lost contact with caregivers. However, the downside of vocal crying is that it may attract the attention not only of caregivers—there is also the risk that strangers, including potential assaulters, may locate the infant and harm it. In addition, the annoying and irritating properties of

vocal crying might even in parents and caregivers stimulate abusive reactions and infanticide (Fessler and Moya 2009). Perhaps it is the latter characteristic of vocal crying, together with the fact that it is relatively metabolically demanding, that has imposed a selection pressure that promoted the gradual replacement of loud vocal crying with silent tears as infants grow older. In turn, tears that evolved as a signal that promotes caregiving and maybe even the attenuation of aggression (the evolutionary process on which we elaborate below) could additionally buffer the possible negative effects of vocal crying by promoting caregiving rather than aggressive impulses (Riem et al. 2017). Importantly, in such situations, tears would be most functional if their influence is tailored to the specific individual that has been attracted by the vocal crying. More precisely, if a caregiver is attracted it would be best if the tears additionally stimulate caregiving reactions, particularly when the caregiver is also annoyed by the vocal crying. If the attracted individual is a stranger, it would be ideal if (s)he feels a bond with the infant that prevents him/her from neglecting it. Finally, in the case of an assaulter, the optimal effect would be if the tears inhibit aggressive impulses. In that way, tears and vocal crying nicely complement each other. In the remainder of this section, we will elaborate on how each of the three social effects of crying we propose here (i.e., soliciting succor and care; promoting social bonding; inhibiting aggression) have developed and are maintained through cultural influences.

After Infancy

Of further relevance for understanding the functions of crying is its developmental course after infancy. Unsurprisingly, changes in crying behavior are, at least partially, linked to other processes of maturation and growth. For example, at the age of 9–11 months, a well-known phase in which the fear of strangers develops, infants cry when exposed to strangers and strange places (Bayley 1932). At a more advanced age (beginning in the third to the fourth year), children become more autonomous and can move on their own and approach caregivers when needy, instead of stimulating them to move toward the child. In this phase of development, the vocal signaling becomes less necessary. Instead of a full-blown and potentially dangerous acoustical signal (e.g., annoying caregivers or attracting predators), a "light," predominantly visual variant of crying would suffice, and therefore, vocal crying gradually subsides. Being devoid of the often aversive and annoying (for others) acoustical aspects (e.g., Lin and McFatter 2011), tears can be targeted at specific individuals (e.g., one's mother, caregiver, or someone else who may be expected to deliver care or protection), with the obvious advantage that others to whom they are not directed (strangers, peers, predators, etc.) will not notice the helplessness and weakness of the sender of the signal. However, one may still wonder why such a mechanism would not make sense for other animal species as well, and why only humans have developed the capacity to shed emotional tears.

The Evolution of Tearful Crying

The question of why tears evolved only in humans and not in other species can be answered by referring to (1) our extreme neoteny, described above, and (2) our

relatively prolonged childhood. The immature human brain keeps developing after birth, which turns children, with all their limitations, into real "learning machines," with their play behaviors contributing significantly to their further cognitive and socio-emotional development (Kipp 2005). This unique plasticity, made possible by the intensive nurturance that human offspring receive, was crucial for the evolution of our ability to adapt to different environments. For that to be possible, as they age, children remain very susceptible to external influences and are still largely dependent on adults. Given this dependency, it is extremely important to be equipped with a behavior that can effectively elicit the necessary care, love, and protection of others.

To satisfactorily answer the question concerning the uniqueness of tears for humans, it is also necessary to understand why weeping (and not another type of visual signal with the same function) has evolved. Also of interest is whether tears first developed in infants, in children, or in adults. These questions are not easy to answer, but we nevertheless try to offer some plausible explanations. First, it is obvious that such a subtle and exclusively directed signal should be visible in the face, which is the main display location of all emotional expressions. These expressions make use of our unique facial musculature, which has evolved in response to functional demands associated with specific ecological factors and the human social system (Burrows 2008). Approximately 200 million years ago, the common ancestors of mammals underwent development of the facial muscles that gave them the capacity to suckle milk. In humans, the further development of the facial musculature and, in particular, the greater opportunities for specific innervation from the motor cortex (Morecraft et al. 2004), together with the loss of facial hair, allowed them—more than any other species—to express a wide variety of emotions, such as anger, surprise, sadness, disgust, fear, and happiness via the facial muscles (Ekman and Friesen 2003; but also see Buck 1994). The face is the most appropriate location for displaying emotions because it is also the main source of information about where an individual is focusing attention (i.e., the eyes) and about an imminent attack (i.e., the mouth), and it thus automatically attracts the attention of others. However, for certain psychological states, the facial musculature apparently did not provide a sufficiently clear and strong means of information transmission, which resulted in the emergence of tears (and, for example, blushing) as additional signals that could modulate the effects of existing muscular expressions. Moreover, although tears may seem rather subtle in comparison to most of the facial expressions because of the small area of the face involved, they may nevertheless compete with the others in salience because of the general inclination of humans to focus on the eyes. The power of tears has been clearly demonstrated in several studies, showing that, when study participants are exposed to pictures of crying individuals with the tears digitally removed (e.g., Cornelius et al. 2000; Provine et al. 2009), they found it extremely difficult to determine which emotion is expressed. Even with extremely brief exposure times (50 msec), the presence of tears facilitates the recognition of sadness and a strong need for support (Balsters et al. 2013).

Regarding why humans developed tearful crying, some hypotheses can be found in the literature, all of which have two aspects in common. First, they focused on adults (and possibly older children, but certainly not infants), and second, they sought an explanation for the connection with suffering. For example, Murube (2009b, 2009c) and Provine (2012) both speculated that the first visible tears for our ancestors were associated with eye infections or damaged eyes that limited vision and thus were an

unambiguous characteristic of an individual in need of help. Alternatively, Graziano (2014) proposed that our ancestors were in the habit of punching each other on the nose, which he expected to typically result in superfluous tear production. Subsequently, through a process of ritualization, the tears produced by physiological distress became associated with psychological distress and helplessness. Ritualization, in this specific case, refers to an evolutionary process by which behaviors accompanying distinct emotions gradually became exaggerated, more visible, distinctive, and/or prototypic in order to function as reliable and effective signals (Eibl-Eibesfeldt 1989). However, we are skeptical of these hypotheses and put forth a more simple and plausible alternative. Rather than focusing on adults, we feel that the explanation for tearful crying can be found in infant crying. Like all vertebrates, we are equipped with lacrimal glands that are necessary for the production of reflex tears, which serve to protect the eye against potentially noxious physical and chemical stimuli. Occasionally this can result in copious tearing and spilling. The sensitive receptors in the cornea may also trigger the production of tears by the lacrimal gland when they are mechanically stimulated, as in the case of yawning, vomiting, and laughing. Strong contractions of the eye muscles in such situations may be held responsible for this phenomenon. In a similar vein, and as was speculated by Darwin (1872), it seems plausible that tears first appeared in infants as a by-product of vocal crying. However, we propose that tears were subsequently coopted to become a visual signal of an infant's suffering and neediness. The latter processes could have been facilitated by the advantages of tears over vocal crying that we discussed above. This might also explain why we are the only species that weeps since no other species produces distress calls that are associated with strong contractions of the eye muscles that result in a substantial pressure on the eyes.

If tears evolved in this way as a signal that is specifically designed to influence caregivers, the next question is how they became a signal that is also relatively frequently emitted by children and adults. It is obviously in the parents' genetic interest to react to their infants' behavior signaling need for nurturance, but it is less clear why humans would react to such behaviors in adults, especially when the adults are strangers. Note, however, that tears are predominantly shed in the presence of one's mother or romantic partner, whereas the presence of strangers seems to inhibit the shedding of tears (Vingerhoets 2013). Nonetheless, there are several reasons to expect that non-kin also became increasingly susceptible to manipulation by tears of adults. The most important one is that in the Environment of Evolutionary Adaptedness, our early human ancestors were spending most of their time in relatively small cooperative groups, consisting not just of kin (see also Cosmides and Tooby 2000), but, to a large extent, of genetically unrelated individuals whom they nevertheless met on a regular basis (Hill et al. 2014). Being able to react to a signal that would facilitate the provision of help and support to regular social-exchange partners was crucial for daily cooperation with in-group members (see also Singer 2011). General prosocial inclination of humans that could have evolved within such circumstances could explain why at least some humans respond empathically to tears from out-group others (e.g., Balsters et al. 2013; Hendriks and Vingerhoets 2006). Tears can also impact strangers because they evolved not only as a signal that conveys a state in which one is in need of help but also as a signal that conveys certain intentions, which we consider in the next section, as well as certain personal characteristics of the crier (to be discussed later on).

Tears as a Submission Signal

We propose that tears, through the coupling with vocal infant crying, became associated with a need for help and succor, first in infants and then gradually also in children and adults. In addition to the exclusively human characteristic of having a prolonged nurturance period, during which tears maintained the initial signaling function, the newly evolved appeasement purposes might also have played an important role. This may be particularly true since we assume that this likely occurred before speech was fully developed. Tears blur vision and may render individuals less capable of fighting, which led some researchers to speculate that they represent a signal of submission (see Hasson 2009). Interestingly, as early as the age of one, children of both genders start forming dyadic dominance relations within their peer groups. These relations are based on a series of status negotiation episodes in which children express agonistic (e.g., overt aggression) or submissive behaviors. It is notable that the ethological and comparative-psychological literature regards tearful crying in such status-negotiation episodes as a signal of submission, together with gaze-averting, crouching, cringing, and flinching (Strayer and Trudel 1984). We further speculate that in our evolutionary past, if a child was unable to confront the other child during such a conflict, it could have been adaptive to emit subtle distress calls, such as tears, to alert potential helpers (parents, other kin, and friends). This is possible because the face (and the tears) can be aimed at a specific individual who is present at the scene but not aware of the current insufficient coping repertoire of the crying child, or towards whom the child can move. Here, a unique property of tears in contrast to other facial expressions comes into play: their ability to be visible for an extended period of time (directly, or via puffy skin and red sclera), without the possibility of immediately removing these effects by displaying other emotional expressions. In this way, tears could have been a functional help-eliciting signal that nevertheless precluded notifying (unwanted) others that one had gained a lower status in a dyadic dominance relation (for a similar account on bullying see Simler 2014), and thus preventing an undesirable change in other dyadic relations. This specific feature further contributed to making the production of tears more adaptive, since (loudly) notifying one's social environment about one's relatively lower status might easily result in more aggression and a permanent decrease in social status. Crucially, while at first being a help-promoting signal (including help in the form of defending a child against the aggression of others), tears could thus subsequently have been coopted to become a signal of appeasement or submission. Such a signal would be beneficial for both the crier (directly attenuating the other's aggression but also potentially negotiating status with help from allies) and the attacker (stopping the behavior that became less functional since the dominance relation had already been formed and since it might provoke an intervention from the crier's allies). In addition to potentially explaining how tearful crying extended its functions beyond infant age, the possibility that tears also evolved as a submission signal provides an additional explanation for why crying affects not just close individuals, but strangers as well.

The Reliability of Tears

Above we discussed the properties of vocal crying in the context of reliability as a prerequisite for a behavior to represent an evolved signal. Here we apply the same logic

to tearful crying. Metabolic costs of tears, in contrast to the vocal crying of infants, do not seem to be particularly relevant, making tears less likely to represent an *index* type of signal as described above. This also makes sense because tears are not expected to act in the domain of sibling competition for parental resources to the same extent as vocal crying does. However, tears do bring other potential costs, such as blurred vision, and tearful crying may also result in a decrease in social status in both adults and children if it is used as a submission signal that indicates an acceptance of a lower position in a hierarchy (see above) or if it acts as a cue of incompetence (see Van de Ven et al., 2016). An interesting question is also whether a too-high frequency of tearful crying in late infancy and early childhood could negatively affect parents' allocation of resources to the child in the long run, making them invest more in other siblings. Tears thus could be regarded as a *general handicap* signal (Laidre and Johnstone 2013) in those cases when there are certain shared interests between the signaler and the receiver (e.g., parent and offspring, partners in a social exchange, or winner and loser in a competition for resources and status). Again, such transmission is reliable because fake signaling (i.e., when the signaler is not needy, not in danger) would result in fewer benefits (in relation to the mentioned costs) than reliable signaling. However, as stated above, for something to represent a signal, it must be reliable on average—that is, not necessarily on every occasion. In other words, some signaling behavior can be expected to be false. However, holding the question of origins aside, tearful crying also seems to be under stronger physiological constraints than vocal crying or other emotional expressions. That is, tears (like blushing) are much harder to fake than are other emotional signals. Whereas the muscles of the vocal tract and the facial muscles can be easily activated "on demand" (Ekman and Friesen 2003), the production of tears (comparable to blushing) is much less susceptible to deliberate control (Provine 2012). Nevertheless, we do seem to be able to up-regulate or down-regulate our tearful crying to a certain extent (see Simons et al. 2012), but only through up- or down-regulating certain emotions. This might explain why tears are generally considered a sign of honesty and reliability, as is evident both in the popular literature (see Vingerhoets 2013) and from empirical research (Picó et al. 2017).

In summary, we propose that tearful crying evolved into a strong social stimulus that was literally related to life or death because it elicited support when individuals were not able to take care of themselves. The second step in the evolution of tears was their transformation into signals that conveyed reliable information not just about the individual's physical condition, but also about his/her emotional states. Furthermore, given that (1) emotional tears are unique to humans and (2) their main function is evident in promoting care for other human beings, it is plausible that tears themselves might have had a major impact on our recent evolution. Humans seem to be the only species in which adult individuals possess an unambiguous and honest, silent signaling mechanism that allows them to transmit information about their powerlessness and need for help. Adequate response to such a message likely benefits both the sender, who receives help (or avoids aggression), and the receiver, who either helps genetically related individuals or whose prospects for future collaboration with the crying individual (or other in-group members) increase. Being better able to adequately respond to tears and thus to respond to the needs of kin as well as to adhere to universal norms prescribing cooperation with in-group members (e.g., see Fehr and Fischbacher 2004) helps the individual in getting through the social world and leads to increased inclusive

fitness. Evolution might thus have promoted the development of not just tearful crying, but also the emergence of a mechanism facilitating functional responses to tearful crying. Crucially, the latter mechanism also largely depends on certain cognitive and emotional properties of conspecifics. More specifically, psychological mechanisms underlying empathic abilities and within-group cooperation probably represented a major prerequisite for the development of adaptive responses to the tears of others. Therefore, tearful crying as a signal might have facilitated the coordination of empathic and cooperative responses that represent the core of the ultra-sociality of the human species.

In conclusion, although we do not yet fully understand in what specific ways the shedding of tears ever may have had an adaptive function for the crier, it is clear that tears are extremely powerful to disambiguate emotional expressions and might have stimulated others (and still do so) to display prosocial behaviors.

Universality and Cultural Variation

Another question that is relevant to the analysis of crying as an evolved mechanism is how universal this behavior is and to what extent culture might have an influence. Pioneers such as Charles Darwin (1872) and the American psychologist Alvin Borgquist (1906) were some of the first to address the role of culture and to speculate about cross-cultural differences in crying. They both assumed that one of the main sources of variation in crying behavior was culturally prescribed restraint in the public display of emotions. In other words, whereas crying is a universal phenomenon, there is also much variation, which seems primarily related to differences in the voluntary control of this behavior. For example, when it comes to some specific strong triggers, such as bereavement, crying seems to be quite a universal phenomenon, although there may be several specific restrictions regarding when it is allowed and when the tears should be controlled (Lobar et al. 2006; Rosenblatt et al. 1976). Darwin also noticed the universality of the attitude by which crying was seen as unmanly and a sign of weakness, which resonates with the idea that crying evolved as a signal of both helplessness and appeasement. A vivid example comes from some African cultures, where boys undergoing circumcision are forbidden to cry because, on that occasion, they must demonstrate courage and manliness. However, when they experience any other kind of pain in everyday life, they are encouraged by their mothers to wail their lungs out as a call for help (Mhlahlo 2009).

It is certainly true that social rules prohibiting, permitting, or even prescribing crying vary considerably, not only among different cultures but also within a specific culture, depending on the specific situation. Wellenkamp (1992) provides a nice illustration of the strong cultural influences on crying. According to the traditional beliefs of the Toraja tribe in Indonesia, it is taboo for adults to cry audibly, except after the death of an intimate and during the funeral or a secondary burial, which is a type of ritual. Also, women who are unable to become pregnant are expected, as a remedy for their infertility, to cry together with other women at a rock said to be inhabited by a spirit. Although the prohibition on crying for other reasons is as important as the ban on adultery and cursing someone, this does not mean that crying does not occur in several other situations such as marital quarrels or departures. However, in those cases, the transgressor has to make a sacrificial offering to atone for violating the prohibition.

The only large and systematic cross-cultural study on crying (Van Hemert et al. 2011) yields some remarkable findings. Contrary to expectations, more crying was reported by people living in cold countries, whereas a previous study, also among mainly Western cultures, demonstrated the opposite relationship for emotional reactivity (Pennebaker et al. 1996). Apparently, crying takes a special role as an emotional expression. In these colder countries, which are also more individualistic, people may experience less social pressure and more freedom to express themselves than people living in warmer and more collectivist countries.

For the time being, and based on the well-grounded idea that crying represents an attachment behavior, which is by definition "reserved" for communication between intimates, we hypothesize that the cultural variation in crying will be predominantly limited to public settings, whereas we do not expect much cultural variation in crying in more intimate settings. Thus, in particular during funerals, memorial events, praying, and other social gatherings, crying may be more likely to be under the influence of implicit or explicit display rules. Anthropologists have explicitly devoted attention to the role of weeping in all kinds of ceremonies and rites. It is tempting to speculate about the correspondences in the functions of common weeping, common praying, and common singing or ritual wailing and how they relate to the functions of crying in private, more intimate settings. These aspects will be discussed more extensively below in the section on the interpersonal functions of crying. For now, it can be concluded that crying is a universal behavior. However, its utilization and social acceptance has also depended, to a great extent, on specific contexts and social variables (social class, religion, etc.; Dixon 2015; Lutz 1999).

After the analysis of the possible evolutionary path that led to the emergence of tearful crying and after taking into account the role of culture, an obvious subsequent question is what specific situations elicit emotional tears in modern human adults. How do the empirical data on the antecedents and contexts of crying fit the functions of tears discussed above? In what follows, we first discuss how the antecedents of crying develop over the lifespan, illustrating both important consistencies as well as remarkable changes. For the remainder of the text, the focus will be mainly on adult tears.

The Antecedents and Contexts of Emotional Tears

Not only lay people but also researchers and clinicians associate crying, and tears in particular, with sadness. For example, Provine et al. (2009) exposed study participants to pictures of crying individuals and the same pictures with the tears digitally removed. The task of the participants was to rate the intensity of the expressed sadness, which appeared to be stronger when tears were visible. From a functionalist perspective, expressing sadness is a reaction to irrevocably lost goals (Lench et al. 2015), which undoubtedly fits the idea of tears as a signal of helplessness. However, does this prove that tears predominantly express sadness? Not necessarily. As mentioned earlier, Darwin (1872) discussed emotional tears not only in his chapter on suffering but also when addressing tender feelings. Most adults can become tearful in reacting to a romantic or sentimental movie, story, or music, apparently without any connection to sadness. Moreover, infants mainly cry not because they feel sad, but rather to elicit physical contact and caregiving when experiencing (physical) discomfort, such as

hunger, pain, or cold, and, especially, when separated from the caregiver. The importance of crying as a specific response to separation from the parents is acknowledged in attachment theory (Bowlby 1969; Nelson 2005). This theory considers crying to be an attachment behavior, similar to smiling, gazing, and grasping, all of which are designed to maintain proximity between the infant and its caregivers. Consequently, crying is predominantly associated with loss and separation. Since these issues stay important over the entire life span, one can expect that losses, romantic breakups, and homesickness are among the most important triggers of tears. Interestingly, Bosworth (2015), in his analysis of crying in ancient prayers, also concludes that deities can be considered as attachment figures or powerful (in a way, parent-like) social exchange partners. Relatedly, in many cultures, weeping was and is especially displayed during preaching, praying, and confession, and also during particular rituals, which often have in common the forming or restoration of a mutual attachment relationship (Lutz 1999).

Clearly, the question of what kinds of situations make people cry cannot be answered adequately without taking the individual's developmental stage into account. There is some suggestive evidence that, as we grow older, the reasons we shed tears become more diverse, and this diversification is, not surprisingly, partially related to certain aspects of socio-emotional development. Physical pain and discomfort are important triggers of tears in infants and children until late adolescence, but at more advanced ages these factors seem less important as triggers of tears. Adults and the elderly seldom cry much when they hurt themselves, but the suffering of others becomes more relevant as trigger of emotional tears. As our empathic skills develop, particularly during adolescence, we no longer cry mainly because of our own suffering and distress, but also because of others' distress, even of fictional and cartoon characters in novels and films. Another remarkable development is that adults do not limit the shedding of tears to negative situations; they also weep when witnessing positive actions such as altruism, bravery, self-sacrifice, and other acts representing virtues (Tan and Frijda 1999), as well as the intensification of relationships, such as represented by love, reunion, patriotism, solidarity, connection, compassion, and devotion (Fiske et al. 2017). These tears seem to communicate to others that one feels strongly attached to the fundamental social and moral values of the society (Cova and Deonna 2014). Finally, tears have been found to play a role in aesthetic emotions, in particular when listening to music (Konečni 2005).

Helplessness has long been considered the key underlying factor in situations that stimulate tears, especially when it comes to situations that provoke negative emotions. Vingerhoets et al. (1997) obtained empirical support for this notion when they observed that the self-reported emotions accompanying crying often included helplessness. The respondents indicated that powerless anger (especially in the case of women; see Vingerhoets 2013), or the combination of powerlessness with fear or sadness, was held responsible for the tears. In the case of positive emotions, the tears may result from overwhelming joy or elation, which makes the individual feel helpless in the sense that they are not able to control their own emotions or do not know how to express themselves (see below). Another way to stress the crucial role of helplessness is to depict crying as an indication that an individual's coping repertoire is currently failing to deal adequately with environmental demands. This supports the idea that one of the main functions of tears, particularly in negative emotional situations, is to convey the message that the crying individual is in need of support (Vingerhoets et al. 2016).

In an attempt to bring some order to the seeming diversity of the antecedents of crying, Vingerhoets (2013) summarized the negative and positive counterparts of similar types of situations that can elicit crying (Table 1). It thus seems that distress associated with human relationships, in particular (the threat of) loss and separation, and powerlessness or weakness (and, to a lesser extent, physical pain) form the common theme of negative crying eliciting experiences. This fits with the notion of crying as an attachment behavior with the promotion of the proximity of significant others and the provision of help and succor by these people as the main functions (Nelson 2005). Interestingly, at an advanced age, the positive counterparts of these negative situations also seem to gain the capacity to provoke tears.

A still unanswered and intriguing question is whether all crying episodes have a single functionally relevant element in common. First, if the evolved functions of tears are evident in the promotion of both helping/nurturing responses and the attenuation of aggression in others, this might have important implications for a more general characteristic of such a signal. More precisely, both the distress signal (help-seeking) and the submission signal (aggression-reduction-seeking) imply requesting a prosocial response from the receiver of the signal, while the sender is weak and helpless. Crucially, the receiver would not likely provide any of these prosocial responses if (s)he does not perceive the sender's intentions to be friendly as well. To put it differently, requesting prosocial responses from others while at the same time expressing weakness might *always* be regarded as a sign of submission, irrespective of whether the requested prosocial responses are in the form of helping behavior or in the form of reduction of aggression. Interestingly, crying seems to be inhibited by increased levels of testosterone (see Vingerhoets 2013), which may indicate that crying is an index of lower testosterone levels, which are known to be related to submissive and, correspondingly, non-aggressive behaviors (see Archer 2006). In each case, tears seem to represent a signal of warmth, an absence of hostility (see below), and an invitation to engage in cooperative behavior, which provides a basis for the explanation of the effects of crying on others.

Table 1 Antecedents of adult tears (Vingerhoets 2013)

Death/loss	Childbirth
Divorce, romantic breakup	Weddings
Separation	Reunion
Conflict	Harmony, comradeship
Loneliness, solitude	Social bonding, union
Defeat	Victory
Powerlessness failure	Extraordinary performance
Emotional suffering	Ultimate happiness, rapture
Feeling old, discarded, worn out	Young, vulnerable, with potential
Sin, egoism, the world is bad	Justice, altruism, the world is good
Tiny, vulnerable, helpless	Overwhelming, (al)mighty, awesome
Physical pain	Orgasm

Next, it seems that tears particularly appear when one gives up control over one's own (emotional) behavior or over the situation in general. In most situations an individual is not entirely deprived of all behavioral options, which makes it less plausible to pinpoint helplessness as a crucial tear-provoking factor. However, occasionally it may be advantageous to switch to a form of passive (or emotional) coping—for example, if one's current resource expenditure is too high or simply not effective. In addition, in situations in which an individual may benefit from another's prosocial behavior (providing help, aggression reduction, communal action), it might be beneficial to yield control over the situation to more powerful or competent others (a mother, a powerful foe, an in-group, or even something that is perceived as overwhelming, such as a musical masterpiece). Such a view is useful in explaining the phenomenon of crying in response to positive events. Feelings of being overwhelmed and the intense experience of something being greater than the individual, which can follow from both positive and negative emotional events, may trigger a decrease in the organism's active coping. Tears thus seem to signal the tendency to yield control over the situation and switch to *more passive coping*, while conveying the absence of hostility and an invitation and encouragement to engage in prosocial and cooperative behavior.

The broader context of crying should also be taken into consideration. In an international study with more than 5500 adult participants, Vingerhoets (2013) collected detailed information on the antecedents and context of the respondents' most recent crying episode, asking questions such as: What time was it? Where were you? Who was with you? How did others respond to your tears? The answers were both remarkable and relevant. For example, the most common time to shed tears is between 7.00 PM and 10.00 PM, when we are most often exposed to a variety of potentially tear-eliciting factors. This is when we watch emotional movies or listen to our favorite music, but also when we have arguments with intimates. We are in a safe place, with no strangers present, and perhaps fatigue lowers the crying threshold or makes it less easy to control our tears. The absence of strangers might indicate that less pressure is felt to do so. Indeed, we are most comfortable with crying in the company of our mother or our romantic partner—in terms of attachment theory, both are important figures. This also makes sense in relation to a phenomenon we refer to as "delayed crying." For example, when a conflict or other emotional situation occurs in a work setting, tears are often inhibited. They first start to flow when discussing the situation at home. The crucial role of attachment figures is further made evident by the finding that students with romantic partners tend to cry more often than their single counterparts (e.g., Sung et al. 2009; Vingerhoets and Van Assen 2009). Also, although lonely people report relatively low well-being, they tend to cry less than their peers who have more social bonds, more support, and someone to cry with (Vingerhoets 2013). Overall, these contextual conditions of tears strongly suggest that people mostly cry in the presence of a sympathetic, close person who likely provides a prosocial response.

Taken together, the observations and empirical findings elaborated in this section seriously challenge the popular view that emotional tears predominantly represent sadness. The production of tears implies that observers are expected to provide prosocial responses, which might explain in part why the broader cultural, and moral and religious, context also plays an important role in shaping this complex behavior (Dixon 2015; Lutz 1999). When in the company of strangers, we are generally reluctant to weep, and we do our best to suppress our tears, or we withdraw and isolate ourselves

unless our culture expects us to show tears. On the other hand, when intimates are present, we seem to cry more easily. Such findings clearly resonate with the attachment-related functions of tears proposed above, as well as with the idea that tears represent a signal whose function is to evoke prosocial responses from others. When the individual perceives that support is available, yielding control and switching from active to passive coping strategies more likely occurs. A further important step in explaining why humans weep is to examine how tears impact the crier and how others react to our tears. In the next section, we evaluate recent empirical evidence for the theoretically expected effects of tearful crying.

The Functional Value of Tears

In the modern psychological and psychiatric literature on adult crying (see Vingerhoets 2013 and Vingerhoets and Bylsma 2016 for review), two possible major functions of adult crying have been postulated: (1) catharsis and emotional recovery (the "intra-individual" functions) and (2) signaling to others the need for succor, which results in a disruption of the ongoing behavior of others and directing their attention to the crier (the "inter-individual" functions). This distinction is also reflected in the model of Shariff and Tracy (2011), who, building on Darwin's (1872) proposal, distinguish between two functions of emotional reactions: (1) preparing the organism to respond adaptively to the acute environmental demands and (2) communicating critical information to others. This model poses that in principle every emotional expression might have (or initially had) an intrapersonal function, which subsequently evolved into an interpersonal function, typically through the process of ritualization as explained earlier. For emotions such as fear and anger, this model is quite easy to understand. In fear, for example, widening of the eyes increases sensory intake, and at the same time it conveys information about the fearful state of the individual. However, for crying this seems a bit more complex since the direct positive consequences for the crier of shedding tears are less clear. The adaptive facial changes (such as the widening of the eyes in the above example of fear) are not the only aspect of an emotional response with (direct) intra-individual functions. Facial expressions represent just one component of a whole cascade of cognitive, physiological, and behavioral reactions that constitute an emotion. Below we address both the intra-individual and the inter-individual effects of tears and how they can be considered.

Intra-Individual Effects of Tears

In the analysis of the potential functions of tears, one may easily confuse real functions of tearful crying with possible by-products of these functions. More specifically, an individual may experience mood improvement (which is often referred to with the term *catharsis*) not as a direct result of the crying, but rather because (s)he has received help from others (a consequence of the evolved communication function) or the crier may feel the relief that is a by-product of an evolved somatic reaction that occurs when an individual is switching to *more passive coping*. As we mentioned earlier, asking for help or giving up in conflict assumes a different pattern of physiological activation and cognitive effort than trying to actively solve the situation alone or insisting on further

conflict. While such passive responses are likely functional (e.g., in terms of decreased metabolic costs and the discontinuation of dangerous or pointless activity), the other connected aspects (e.g., feeling relief) might instead be a mere by-product. In short, we believe that tearful crying represents a (signaling) component of a wider set of reactions whose function is to prepare the organism to switch to passive coping and to expecting prosocial responses from others. In what follows, we discuss the intra-individual effects of tearful crying that, if present at all, most likely represent by-products of either the *passive coping* function, or of the inter-individual function of tears.

In the popular as well as the clinical literature, one often comes across the notion that emotional expressions in general and crying in particular result in tension reduction and even health benefits (Cornelius 1997, 2001). The postulated importance of crying in the clinical setting was first emphasized in the late nineteenth century by Sigmund Freud and Josef Breuer (Breuer and Freud 1974), who emphasized the link between crying and catharsis. Crying was considered a kind of safety valve that facilitates the release of emotional energy that otherwise might result in psychosomatic disturbances. A biochemical variant of this notion was introduced by Frey (1985), who proposed that the major tear glands—comparable to the kidneys—cleansed the blood from stress hormones and toxic waste products that he deemed responsible for low well-being. This specific biochemical hypothesis has never been scientifically verified, but other possible mechanisms, such as the (endogenous) release of endorphins or oxytocin seem more plausible (see Vingerhoets 2013) and therefore deserve serious attention and consideration. However, thus far no studies have specifically addressed these issues.

In the past decade, however, there has been accumulating evidence (see Gračanin et al. 2014; Rottenberg et al. 2008) that crying does not necessarily result in mood benefits, but that its effects depend on specific factors connected with the crying individual, the eliciting event, and, in particular, the reactions of observers. More specifically, people who are suffering from depression or anxiety, although they probably cry more frequently, hardly, if ever, seem to benefit from it (Rottenberg et al. 2008). Also, the specific situations that make us cry can be decisive. Uncontrollable negative events (e.g., the death of an intimate) are less likely to result in relief than more controllable situations (e.g., a conflict situation). Moreover, how others respond to one's tears is extremely important. When observers react with understanding and comfort, the result is a completely different story than when they react with disapproval and irritation. Further, a handful of laboratory studies have demonstrated that, when study participants were exposed to an emotional film that made them cry, they consistently reported a worsened mood immediately after the film, compared with baseline mood measured just before the film (for an overview see Cornelius 1997, 2001). However, Gračanin et al. (2015) found some indications that it might take more time for the positive effects of tears on one's mood to occur. We currently do not know how to evaluate these results; the possible mechanisms might be physiological (e.g., endogenous opioids, oxytocin), cognitive (ranging from biases to cognitive emotion regulation strategies), behavioral (e.g., interrupt one's ongoing activities and try to relax), or social (e.g., receiving comfort from others). Except for the social consequences of tears, these potential effects do not seem to represent an evolved function of tears but rather should be considered a by-product of mechanisms involved in concurrent processes.

Although the mechanisms of such effects are still unknown, in many cultures and time periods, the idea that tears have the capacity to wash away pain and painful effects seems more common than its opposite (i.e., that tears increase an individual's pain). In particular, in mourning rituals, the bereaved may cry because of the conviction that it helps them to cope with their sorrow (Lutz 1999). The overlap between intra- and inter-individual effects of crying may thus be the consequence of the basic human need for social connection. When an important affective bond is lost, the emotional response may facilitate expressions that help to restore that bond. In the case of a significant permanent loss, weeping may bring people to the same mental state, which may be experienced as a sensation of comfort that compensates for the original loss. In this way, this phenomenon may help to raise the social vitality of the group (Durkheim 1965).

On the level of the individual, the accounts of the positive psychological effects of tears in the popular literature are numerous. As Ovid noted centuries ago, "It is some relief to weep; grief is satisfied and carried off by tears." Hanser et al. (2016) found that, next to listening to specific music, respondents mentioned crying as the second most important way to induce self-comfort. Adults have the capacity to regulate their emotions and emotional expressions, as shown by Simons et al. (2012), who demonstrated that up-regulation of crying occurs predominantly when the goal is to achieve catharsis in the immediate situation, although these strategies can also be employed for interpersonal reasons (e.g., to show others how one feels or to display the appropriate emotions in a specific setting, such as a funeral). Interestingly, from a historical perspective, especially among religious persons and mystics (e.g., St. Augustine, St. Ignatius of Loyola, Martin Luther, Margery Kempe), crying was thought to be evidence of compunction and a corresponding washing away the effects of sins. This baptismal cleansing or lacrimal washing was thus expected to result in purification, which might be closely linked to the more secular concept of catharsis discussed above (Dixon 2015; Lutz 1999).

A further possible intrapersonal effect of tearful crying concerns the feedback that it may provide to the crier. As discussed above, adults cry not only in negative situations, such as losses, failures, and helplessness, but also in positive situations, e.g., when witnessing the intensification of relationships, prosocial behaviors, and exceptional performances (see Table 1). Perhaps, once we are adults, tears act like exclamation points—signals to ourselves that remind us of our ultra-social nature and stress the importance of good social and moral functioning. In a way, crying is the opposite of emotions such as disgust, which emphasize the evil and wrongness of immoral and antisocial behavior. Firstly, when a tearful reaction occurs as a relatively automatic response before complex cognitive appraisal processes are activated, the awareness of the tears may also draw the crier's attention to the importance of certain moral acts and facilitate further cognitive elaboration. Although such effects also likely represent only a by-product of the signaling function of tears, they might nevertheless play an important role in the everyday functioning of humans. Furthermore, recent research in moral psychology suggests that intuitive emotions such as disgust and elation serve as a moral compass—not just because they provide a basis for more cognitively elaborated moral judgment, but also because they influence prosocial behavioral intentions (e.g., Haidt 2007; Schnall et al. 2010). In particular, feelings of being moved, which are prototypically coupled with tears, seem to motivate individuals to act

communally, share, and care (Fiske et al. 2016; Menninghaus et al. 2015). Finally, tears that accompany such affective responses might also convey information about the criers' prosocial intentions to others and motivate them to act in accordance with those norms. This corresponds to our earlier notion that such tears might convey to others that the criers share important social and moral values. In previous times, it was said that only good men weep (e.g., Bayne 1981). Maybe there is a kernel of truth in that early conviction.

Inter-Individual Effects of Tears

In the section on infant crying, we discussed the importance of vocal crying (and the accompanying tears) to convey a need for help. Subsequently, we addressed the signaling value of (child and) adult tears in the context of both the elicitation of support and the reduction of aggression. The fulfillment of these functions is strongly dependent on how the observers react to tears. Here, we review the results of research on the interpersonal effects of adult tears.

Van Kleef (2016) makes the important distinction between two broad categories of reactions to emotional expressions in general: (1) *affective reactions*, which can take the form of reciprocal (e.g., emotional contagion, perspective taking, social appraisal) or complementary (anger can induce fear, sadness can trigger anger, etc.) reactions, and (2) *inferences about the expresser and the situation (s)he is in*, resulting from more conscious cognitive processes (versus more automatic implicit proceses). For example, on the basis of information inferred from an emotional expression, observers may draw inferences concerning how the expresser appraised the situation, his or her personality (e.g., warmth, competence, reliability), social status, social motives, and specific behavioral intentions. Both kinds of reactions subsequently determine the observer's behavioral responses.

Regarding the first category of reactions, empirical support for the notion that tears have a clear signal value has been provided in several studies (e.g., Balsters et al. 2013; Cornelius and Lubliner 2003; Cornelius et al. 2000; Hendriks and Vingerhoets 2006; Provine et al. 2009; Vingerhoets et al. 2016; Zeifman and Brown 2011). Further, individuals who do not cry reportedly receive less emotional support (Hesdorffer et al. 2017). In short, visible tears strengthen the perception that the person is sad and helpless. Digital removal of tears from photographs revealed that they resolve the ambiguity of facial expression: the deletion resulted in reports of expressions of uncertain emotional valence, varying from awe, concern, contemplation, fright, and puzzlement to, occasionally, sadness. Tearful faces also elicit more sympathy and feelings of being connected (Vingerhoets et al. 2016; Zeifman and Brown 2011). Consequently, people seem more willing to help a person who is crying. This is clearly in line with the idea that tears represent an evolved adaptation that facilitates helping behavior in others.

When it comes to the second category of reactions, crying individuals are typically perceived as warm, empathic, reliable, sincere, and less aggressive, all of which reflect prosocial intentions, but also less emotionally stable, incompetent, and weak (Hendriks et al. 2008; Picó et al. 2017; Van de Ven et al. 2016; Vingerhoets et al. 2016; Zeifman and Brown 2011). In other words, tearful individuals elicit more positive evaluations, but when observers themselves need help, they seem to avoid individuals who are

crying. Either they do not want to burden a distressed individual with their troubles, or perhaps also because of the attributed weakness and lack of competence (Van de Ven et al. 2016). These research findings illustrate that tears, in particular, emphasize helplessness and need for support, but they also promote feelings of empathy and social connectedness in others. To put it bluntly, tears convey a variety of inferences about the sender, both negative and positive, but never that the crier is disingenuous or aggressive and prone to violence.

A major limitation of these laboratory studies is that they are rather artificial and consequently may suffer from limited ecological validity. They are mainly based on self-reports, rather than real behavior. The strict experimental conditions make it possible to disentangle the contributing effects of specific factors, but it is not clear to what extent well-known factors such as social desirability and pleasing the experimenter may act as confounders. Surprisingly, there are few data from real-life studies on how others react to tears. One important exception is the International Study on Adult Crying (ISAC: Van Hemert et al. 2011), in which respondents reported how strangers and intimates reacted to their most recent crying episode (Vingerhoets 2013). These data revealed that the specific relationship between crier and observer is important. Reacting to crying individuals by providing (physical and verbal) comfort and understanding seemed far less likely for a stranger than for an intimate. These findings once again seem to support the idea that crying is (primarily) an attachment-related behavior (see also Bowlby 1969, 1980; Nelson 2005). Another interesting and detailed analysis of reactions to crying, specifically in the work-place, is provided by Elsbach and Bechky (2017). This study revealed that observers of crying in a professional context were most likely to attribute negative dispositions to the criers (e.g., that they were weak/emotional, unprofessional, or manipulative) if they had noticed that the criers had violated a specific, often implicit, behavioral script and/or if the observers experienced strongly negative emotions (i.e., annoyance or anger) when being confronted with the crier. On the other hand, more positive, situational attributions of criers (e.g., that they were dealing with a tough situation at work or at home) were made if the observers felt that the crier had confirmed a specific behavioral script and if the observers experienced more neutral or positive emotions. Surprisingly, the induced underlying emotions experienced by the crier failed to influence observers' attributions of the criers. Both the ISAC and this study thus clearly demonstrate that reactions to crying individuals are not by definition positive. Rather, several factors (observer-related, mutual relationship between crier and observer, etc.) moderate the ultimate behavioral reactions. Along these lines, Van Kleef (2016) specifically emphasizes the perceived appropriateness of the emotional expression, as well as the capacity and motivation of the observer to process the information adequately.

Several anthropological studies and historical accounts present interesting observations of real-life crying and in particular of ritual weeping. What do these observations teach us about the (anticipated) effects of crying on others? The presumed effects of tears on others (including deities) can been seen in the Old Testament and in ancient prayers (Bosworth 2013a, b, 2015). These examples mainly concern individuals using tears to reinforce their prayers and express the need for assistance, as well as to reinforce the message that they are obedient and thus deserve their prayers to be answered. For example, King David is a good illustration of an individual weeping to please his God. When his son fell seriously ill, he spent a night lying on the ground, shedding tears. Remarkably, he did so only when his son was still alive. After being

informed that his son had died, he stopped his weeping. Why he did so is an object of debate, but there is little doubt that his tears were meant to support his pleas. This not only occurs with prayer, but also in the case of requests to powerful people and for other strategic reasons (Ebersole 2000). Moreover, it not only occurs in private situations; there are many descriptions of shared weeping by a tribe or group of people directed at a deity. In all these instances, there was an eminent expectancy of a benevolent response from the entity to which the tears were directed, as we will show in the next section. On the other hand, there is also always the risk that observers do not react with understanding and comfort, as shown by Elsbach and Bechky's findings. The challenge thus is to come up with a model, in the line of Van Kleef (2016) and Elsbach and Bechky (2017), which is helpful to arrive at a better understanding of the decisive factors that determine the ultimate behavioral reaction to tears.

Ritual Weeping

As said before, in several historical writings, one can find examples of common crying to achieve a certain purpose. For example, before decisive battles, people gathered and wept together in an attempt to compel fortune and luck. Judas and his followers reportedly prepared for the war against the Syrians by fasting, kneeling, and weeping for three days. Further, in several old Eastern cultures, there were special weeping festivals to please gods of fertility. Worldwide (from the Aztecs in Mexico to medieval Spain and modern Tunisia), weeping processions or other rites were held to stimulate deities to produce fertilizing tears (i.e., rain) (Christian 1982; Read 2005). Weeping was also an important part of penitential festivals, which were often organized after disasters like drought, failure of crops, diseases, swarms of locusts, or defeat in wars. In all of these cases, the ritual weeping can be regarded as an appeal of relatively powerless and helpless individuals, who throw themselves at the mercy of a powerful other. In that sense, tears can be regarded as a "last resort," when no other solutions are available (i.e., reflecting helplessness) and also as a submissive response. In the case of bereavement, the common weeping or lamenting could also be meant to propitiate the spirits of those who passed away, because these were believed to be hostile and envious of the living bereaved. Again, all these utilizations of crying can be regarded as pleas for help and mercy from a mightier power. An expression of humility or a humble ritual position was expected to move the deity to pity the crier. It might be reasonable to expect that weeping ritualizes more easily when the involved individuals also would like to receive support from their tribe members as well. Ritual weeping thus may originate from a more conscious attempt to influence others (powerful others, deities, and tribe members as well), which is in line with recent findings of the utilization of tears to manipulate others (Simons et al. 2012). Note that this does not necessarily contradict the idea of tears as an honest signal, in a sense that they can be considered as a spontaneous response that can nevertheless be facilitated intentionally.

A further remarkable phenomenon, reported by travelers, missionaries, soldiers, and anthropologists since the sixteenth century is the custom of tearful greeting observed among a substantial number of South American Indian tribes, but also in North America, Australia, India, and the Andaman Islands (Harbsmeier 1987). This cultural practice can be analyzed in the light of the hypothesis that tears represent signals of

appeasement and non-aggressive intentions (e.g., Hasson 2009), as well as in the context of findings that tears promote the observer's perceptions of prosocial traits (e.g., Vingerhoets et al. 2016). Therefore, tears during greetings may be easily utilized by cultural institutions as a means to create or strengthen social bonds because of the above discussed, evolved psychological mechanisms that serve signaling functions of tears.

What these situations all have in common is that the involved people are always together with relatives, tribe members, or (new) friends. Crying in this context is thus clearly a social act that is performed as the occasion requires it. Anthropologists regard ritual weeping as an indication that the community feel united and experience a mutual social bond with each other. Radcliffe-Brown (1964) also described as an important sociocultural function of these public tears "to affirm the existence of a social bond between two or more persons." In the same vein, Urban (1988) proposed that wailing is a communicative stylized expression, not primarily meant to signal feelings of loss, but rather to express the desire for sociability. The main aim is to communicate to others that one has the socially correct feelings at the socially prescribed times. So, these tears seem to be shed out of respect or courtesy, rather than out of grief. Interestingly, whereas crying generally is considered as a more typical female behavior, in these rituals, there is often an equal involvement of both sexes.

Rather than being an involuntary behavior that is hard to fake, in certain societies the shedding of tears thus seems to represent a part of the behavioral repertoire of its members that is meant to express feelings of social bonding and solidarity between individuals. The difference between real crying and lamenting may be rather subtle. It has been proposed that lamenting because it is not "diluted" by individual differences, is actually a stronger and more unambiguous signal than real crying, hence its use as a socially proper means of expression under the socially appropriate circumstances. Note here the correspondence with Cova and Deonna's (2014) hypothesis that the tears associated with being moved also express that one shares important cultural and moral values. Another important aspect of the social utilization of tears within the phenomenon of ritual weeping or lamenting concerns their power to facilitate the expression of real emotions in others, even the most hard-hearted. For example, when mourners in traditional Yemenite–Israeli communities are exposed to the (professional) wailers, their sadness comes out (Gamliel 2010). This is considered important, because, also in this community, weeping is generally believed to result in happiness, calmness, and "cooling off." Also, because the bereaved join the audience of a ritual performance, this ceremony promotes the formers' social adjustment.

Based on these examples, it can be concluded that ritual weeping is often based on the workings of the same functional mechanisms as "real weeping." These primarily concern the expression of a need for help and/or submission to get a positive response from important, powerful figures, as well as the strengthening of social bonds. Ritual weeping thus might make people feel more bonded by taking advantage of the evolved intuitions and emotions surrounding weeping. However, according to Ebersole (2000), these are not the only socio-cultural functions of ritual weeping. This author further describes that the lamenting of especially women may occasionally represent a kind of social protest. For example, in former Greece, such laments provided "cover" for women to transgress or violate normal social functioning and prohibitions without the fear of serious reprisals. This also can be seen in other cultures (see Desjarlais

1991). Within these ritual boundaries, the people (often women) have the opportunity to articulate what otherwise could not be expressed or would not be accepted. A paradoxical explanation for the tolerance of the transgressional nature of such utterances may be based on the functional properties of tears that we discussed above. While conveying protest in a specific context, at the same time, they also convey submission and friendly intentions, thereby neutralizing any potential threat. Further, the amount of weeping occasionally also was a kind of yardstick displaying the social status and importance of the deceased (Van Wees 1998). For widows, engaging in ritual weeping may mark their changed social status and constitute a way to display that they adhere proper cultural values. Moreover, their dead husband's honor could be dependent on the behavior (laments and tears) displayed by his wife and female relatives. It is tempting to speculate that the implicit assumption that weeping is an honest signal has contributed to this development of weeping as a signal of proper social and moral functioning.

In summary, we feel that there are some striking correspondences in the reported properties of ritual and mass weeping in different cultures and everyday crying. Crying seems to both convey and provoke prosocial intentions, which in the context of ritual weeping could be additionally facilitated through the generation of a shared emotional experience, which eventually promotes social bonding and feelings of mutual connectedness. Cultural institutions may thus take advantage of the outputs of evolved mechanisms that are activated in both criers and observers of ritualized crying.

Conclusion

We have reviewed the literature on emotional crying, with an emphasis on the psychological, biological, and anthropological literature, from both evolutionary and cultural perspectives. Although in modern Western cultures, crying is particularly linked with sadness with its main assumed function being catharsis, the present review of the scientific literature yields a rather different picture. We do not pretend to come up with definitive answers, but we nevertheless feel that the following conclusions can be drawn. First, rather than being closely connected with just sadness, we consider crying first and foremost, just as it does for infants, a signal to others that one is helpless and/or gives up one's control over the situation. On a more general level, this means that tears are also a signal of the absence of hostility (or even the presence of prosocial intentions) that, in its turn, indirectly promotes prosocial responses in others. In this way, this signal facilitates feelings of connectedness and, consequently, promotes social bonding (Table 2).

Second, it is important to be aware that, over the lifespan, several major developments take place with respect to crying. By gradually replacing the loud vocal crying of infants that evolved from the mammalian distress calls, tears still retain its signaling value, while at the same time they are devoid of some costly properties. For example, they are a means of conveying messages to specific individuals without attracting undesired attention from strangers and potential foes. In addition to the increasing significance of tears over vocal crying, the major ontogenetic changes concern the antecedents of crying, which became much more diverse over the lifespan.

Table 2 Antecedents, meaning, and inter-individual consequences of infant, adult, and ritual crying

	Antecedents	What does it convey?	Reaction of others†
Infant crying	Physical / mental discomfort / separation	Need for help	Caregiving, comfort, physical proximity; reduction in aggression (of strangers and caregivers)
	Poor physical health	Low survival chances	Reduction in investment
Adult crying	Distress	Need for help	Comfort, advice, help
	Separation	Need for help and proximity	Comfort, bonding
	Sentimental/ moral issues	Compliance with proper social and moral values	Bonding, appeasement
	Confession, supplication, guilt	Need for forgiveness, submission	Help, forgiveness (from deities)
Ritual / Common weeping	Disasters	Need for help, to belong, submission	Appeasement (of higher powers/deities)
	Penitentiary festivals	Need for forgiveness, submission	Help (from deities)
	Preparation for war	Display of unity	Bonding
	Bereavement	Compliance with proper social and moral values	Bonding, appeasement (of spirits of deceased)
	Greeting rituals	Absence of hostility, friendly intentions	Bonding

†Refers either to the likely actions of real recipients of the signal or to the (expected) actions of supernatural agents, as construed by the weeping individual(s)

Third, converging evidence both from recent experimental studies and anthropological observations suggest that the most important functions of crying are in the inter-individual domain rather than in the intra-individual domain. Nevertheless, while we consider certain intra-individual effects of tears such as mood improvements to be by-products of other evolved functions, we, on the other hand, propose that tears are coupled with an adaptive intra-individual response that prepares the organism to switch to passive coping and to expecting prosocial responses from others. Anthropological observations further suggest that the production of emotional tears, otherwise considered as an involuntary and purely physiological emotional response, can also be shaped considerably by culture. This, however, does not mean that the original functions of crying have been lost. On the contrary, the main effects of ritualized weeping seem to a certain extent similar to those connected with the evolutionary meaning of the distress or separation call, i.e., a strong appeal to others to provide help, or more generally, to engage in common friendly behavioral interactions. To this end, it might have been helpful to regard tears as a reliable sign of proper social and moral functioning.

Culture is not a fixed given—it is rather dynamic, and this very dynamic nature is reflected not only in how societies appreciate and deal with emotions and their expressions including crying, but culture also seems to exert a significant influence on the emotional responding of people. However, what seems consistent over time and among cultures is that tears convey to others that one gives up control and needs help or comfort. Our capacity to produce emotional tears and to perceive their meaning in a

functional way thus likely have contributed to our evolution to the ultra-social species that we currently are.

Acknowledgments We would like to express our gratitude to two anonymous reviewers for their careful reading of a previous version and their many constructive and very stimulating and helpful comments and suggestions that resulted in much better manuscript. This work was supported by the NEWFELPRO project of the Government of the Republic of Croatia and the MSES (Grant No. 32).

References

Archer, J. (2006). Testosterone and human aggression: An evaluation of the challenge hypothesis. *Neuroscience and Biobehavioral Reviews, 30*, 319–345.

Balsters, M. J. H., Krahmer, E. J., Swerts, M. G. J., & Vingerhoets, A. J. J. M. (2013). Emotional tears facilitate the recognition of sadness and the perceived need for social support. *Evolutionary Psychology, 11*, 148–158.

Barr, R. G. (1999). Infant cry behaviour and colic: An interpretation in evolutionary perspective. In W. R. Trevathan, E. O. Smith, & J. J. McKenna (Eds.), *Evolutionary medicine* (pp. 27–51). New York: Oxford University Press.

Bayley, N. (1932). A study of the crying of infants during mental and physical tests. *Journal of Genetic Psychology, 40*, 306–329.

Bayne, S. P. (1981). *Tears and weeping: An aspect of the emotional climate reflected in seventeenth-century French literature*. Tübingen: Gunter Narr.

Bekker, M. G. J., & Vingerhoets, A. J. J. M. (1999). Adam's tears: The relationships between crying, biological sex, and gender. *Psychology, Evolution, and Gender, 1*, 11–31.

Bekker, M. H. J., & Vingerhoets, A. J. J. M. (2001). Male and female tears: Swallowing versus shedding? The relationship between crying, biological sex and gender. In A. J. J. M. Vingerhoets & R. R. Cornelius (Eds.), *Adult crying: A biopsychosocial approach* (pp. 91–114). Hove: Brunner-Routledge.

Borgquist, A. (1906). Crying. *The American Journal of Psychology, 17*, 149–205.

Bosworth, D. A. (2013a). The tears of God in the book of Jeremiah. *Biblica, 94*, 24–46.

Bosworth, D. A. (2013b). Weeping in the Psalms. *Vetus Testamentum, 62*, 36–46.

Bosworth, D. A. (2015). Ancient prayers and the psychology of religion: Deities as parental figures. *Journal of Biblical Literature, 134*, 681–700.

Bowlby, J. (1969). *Attachment and loss (Vol. 1)*. New York: Basic Books.

Bowlby, J. (1980). *Attachment and loss (Vol. 3): Loss, sadness, and depression*. New York: Basic Books.

Breuer, J., & Freud, S. (1974). *Studies on hysteria*. Harmondsworth: Penguin Books (originally published in 1895).

Buck, R. (1994). Social and emotional functions in emotional expression and communication: The readout hypothesis. *Biological Psychology, 38*, 95–115.

Burrows, A. M. (2008). The facial expression musculature in primates and its evolutionary significance. *BioEssays, 30*, 212–225.

Christian, W. A. (1982). Provoked religious weeping in early modern Spain. In J. Davis (Ed.), *Religious organization and religious experience* (pp. 97–114). New York: Academic Press.

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. 303–321). Tilburg: Tilburg University Press.

Cornelius, R. R. (2001). Crying and catharsis. In A. J. J. M. Vingerhoets & R. R. Cornelius (Eds.), *Adult crying: A biopsychosocial approach* (pp. 199–212). Hove: Brunner-Routledge.

Cornelius, R. R., & Lubliner, E. (2003). The what and why of others' responses to our tears: Adult crying as an attachment behavior. Paper presented at the 3rd International Conference on the (Non)Expression of Emotions in Health and Disease. Tilburg, The Netherlands.

Cornelius, R. R., Nussbaum, R., Warner, L., & Moeller, C. (2000). "An action full of meaning and of real service": The social and emotional messages of crying. Paper presented at the 11th conference of the International Society for Research on emotions. Quebec City, Canada.

Cosmides, L., & Tooby, J. (2000). Evolutionary psychology and the emotions. In M Lewis and J. M. Haviland-Jones (Eds), Handbook of emotion (second ed., pp. 91–115). London: Guilford.
Cova, F., & Deonna, J. A. (2014). Being moved. *Philosophical Studies, 169*, 447–466.
Darwin, C. (1872). *The expression of emotions in animals and man*. New York: Oxford University Press (1998 edition, with an introduction, afterword, and commentaries by P. Ekman).
Davaa, B., & Falorni, L. (2003). *Die Geschichte vom weinenden Kamel [The story of the weeping camel]* (film). Munich: Prokino Filmverlieh (Distributor).
Desjarlais, R. R. (1991). Poetic transformations of Yolmo "sadness." *Culture, Medicine and Psychiatry, 15*, 387–420.
Dixon, T. (2015). *Weeping Britannia: Portrait of a nation in tears*. Oxford: Oxford University Press.
Durkheim, E. (1965). *The elementary forms of the religious life*. New York: Free Press (originally published in 1912).
Ebersole, G. L. (2000). The function of ritual weeping revisited: Affective expression and moral discourse. *History of Religions, 39*, 211–246.
Eibl-Eibesfeldt, I. (1989). *Human ethology*. Hawthorne, NY: Aldine de Gruyter.
Ekman, P., & Friesen, W. V. (2003). *Unmasking the face*. Cambridge: ISHK.
Elsbach, K. D., & Bechky, B. A. (2017). How observers assess crying in professional work contexts. *Academy of Management Discoveries*. https://doi.org/10.5465/amd.2016.0025.
Fehr, E., & Fischbacher, U. (2004). Third-party punishment and social norms. *Evolution and Human Behavior, 25*, 63–87.
Fessler, D. M. T., & Moya, C. M. (2009). Crying (evolutionary perspectives). In K. Scherer & D. Sander (Eds.), *The Oxford companion to the affective sciences* (pp. 105–106). New York: Oxford University Press.
Fiske, A. P., Schubert, T., & Seibt, B. (2016). "Kama Muta" or "being moved by love": A bootstrapping approach to the ontology and epistemology of an emotion. In J. Cassaniti & Y. U. Menon (Eds.), *Universalism without uniformity: Explorations in mind and culture*. Chicago: University of Chicago Press.
Fiske, A. P., Schubert, T., & Seibt, B. (2017). The best-loved story of all time: Overcoming all obstacles to be reunited evoking Kama Muta. *Evolutionary Studies in Imaginative Culture, 1*(1), 67–70.
Fossey, D. (2000). *Gorillas in the mist* (revised ed.). New York: Houghton Mifflin.
Friedman, S. L., Jacobs, B. S., & Werthman, M. W. (1982). Preterms of low medical risk: Spontaneous behaviors and soothability at expected date of birth. *Infant Behavior & Development, 5*, 3–10.
Frodi, A. M., Lamb, M. E., Leavitt, L. A., & Donovan, W. L. (1978). Fathers' and mothers' responses to infant smiles and cries. *Infant Behavior & Development, 1*, 187–198.
Frodi, A., & Senchak, M. (1990). Verbal and behavioral responsiveness to the cries of atypical infants. *Child Development, 61*, 76–84.
Frey, W. H. (1985). *The mystery of tears*. Minneapolis: Winston Press.
Furlow, F. B. (1997). Human neonatal cry quality as an honest signal of fitness. *Evolution and Human Behavior, 18*, 175–193.
Gamliel, T. (2010). "She who mourns will cry": Emotion and expertise in Yemeni-Israeli wailing. *Journal of Anthropological Research, 66*, 485–503.
Glocker, M. L., Langleben, D. D., Ruparel, K., Loughead, J. W., Gur, R. C., & Sachser, N. (2009a). Baby schema in infant faces induces cuteness perception and motivation for caretaking in adults. *Ethology, 115*, 257–263.
Glocker, M. L., Langleben, D. D., Ruparel, K., Loughead, J. W., Valdez, J. N., Griffin, M. D., Sachser, N., & Gur, R. C. (2009b). Baby schema modulates the brain reward system in nulliparous women. *Proceedings of the National Academy of Science, 106*, 9115–9119.
Gračanin, A., Bylsma, L. M., & Vingerhoets, A. J. J. M. (2014). Is crying a self-soothing behaviour? *Frontiers in Psychology, 5*, 502.
Gračanin, A., Vingerhoets, A. J. J. M., Kardum, I., Zupčić, M., Šantek, M., & Šimić, M. (2015). Why crying does and sometimes does not seem to alleviate mood: A quasi-experimental study. *Motivation and Emotion, 39*, 953–960.
Graziano, M. (2014). The first smile. Aeon (online). http://aeon.co/magazine/science/should-we-ever-take-a-smile-at-face-value/.
Haidt, J. (2007). The new synthesis in moral psychology. *Science, 316*, 998–1002.
Hanser, W. E., Ter Bogt, T. F. M., Van den Tol, A. J., Mark, R. E., & Vingerhoets, A. J. J. M. (2016). Consolation through music: A survey study. *Musicae Scientiae, 20*, 122–137.
Harbsmeier, M. (1987). Why do the Indians cry? *Culture and History, 1*, 90–114.
Hasson, O. (2009). Emotional tears as biological signals. *Evolutionary Psychology, 7*, 363–370.

Hendriks, M. C. P., Croon, M. A., & Vingerhoets, A. J. J. M. (2008). Social reactions to adult crying: The help-soliciting function of tears. *Journal of Social Psychology, 148*, 22–41.

Hendriks, M. C. P., & Vingerhoets, A. J. J. M. (2006). Social messages of crying faces: Their influence on anticipated person perception, emotional and behavioral responses. *Cognition and Emotion, 20*, 878–886.

Hesdorffer, D., Vingerhoets, A., & Trimble, M. (2017). Social and psychological consequences of not crying: Possible associations with psychopathology and therapeutic relevance. *CNS Spectrums*, 1–9. https://doi.org/10.1017/S1092852917000141.

Hill, K. R., Wood, B. M., Baggio, J., Hurtado, A. M., & Boyd, R. T. (2014). Hunter-gatherer inter-band interaction rates: Implications for cumulative culture. *PLoS One, 9*, e102806.

Horstmanshoff, M. (2014). Tears in ancient and early modern physiology: Petrus Petitus and Niels Stensen. In D. Kambaskovic (Ed.), *Conjunctions of soul, body, and mind from Plato to the Enlightenment.* Dordrecht: Springer.

Johnstone, R. A., & Grafen, A. (1992). The continuous Sir Philip Sidney game: A simple model of biological signaling. *Journal of Theoretical Biology, 156*, 215–234.

Kipp, F. (2005). *Childhood and human evolution* (J. M. Barnes, trans.) Hillsdale, NY: Adonis Press. (Originally published as *Die Evolution des Menschen im Hinblick auf seine lange Jugendzeit* in 1991).

Konečni, V. J. (2005). The aesthetic trinity: Awe, being moved, thrills. *Bulletin of Psychology and the Arts, 5*(2), 27–44.

Laidre, M. E., & Johnstone, R. A. (2013). Animal signals. *Current Biology, 23*, 829–833.

Lench, H. C., Bench, S. W., Darbor, K. E., & Moore, M. (2015). A functionalist manifesto: Goal-related emotions from an evolutionary perspective. *Emotion Review, 7*, 90–98.

Lin, H., & McFatter, R. (2011). Empathy and distress: Two distinct but related emotions in response to infant crying. *Infant Behavior & Development, 35*, 887–897.

Lobar, S. L., Youngblut, J. M., & Brooten, D. (2006). Cross-cultural beliefs, ceremonies, and rituals surrounding the death of a loved one. *Pediatric Nursing, 32*, 44–50.

Lummaa, V., Vuorisalo, T., Barr, R. G., & Lehtonen, L. (1998). Why cry? Adaptive significance of intensive crying in human infants. *Evolution and Human Behavior, 19*, 93–202.

Lutz, T. (1999). *Crying: The natural and cultural history of tears*. New York: W.W. Norton.

Masson, J. M., and McCarthy, S. (1995). *When elephants weep: The emotional lives of animals.* New York: Dell.

Maynard Smith, J., & Harper, D. G. C. (2003). *Animal signals*. Oxford: Oxford University Press.

Menninghaus, W., Wagner, V., Hanich, J., Wassiliwizky, E., Kuehnast, M., & Jacobsen, T. (2015). Towards a psychological construct of being moved. *PLoS One, 10*, e0128451.

Mhlahlo, A. P. (2009). *What is manhood? The significance of traditional circumcision in the Xhosa initiation ritual*. PhD thesis, Department of Sociology and Social Anthropology, University of Stellenbosch, Stellenbosch.

Morecraft, R. J., Stilwell-Morecraft, K. S., & Rossing, W. R. (2004). The motor cortex and facial expression: New insights from neuroscience. *The Neurologist, 10*, 235–249.

Murube, J. (2009a). Tear apparatus of animals: Do they weep? *The Ocular Surface, 7*, 121–127.

Murube, J. (2009b). Hypotheses on the development of psychoemotional tearing. *The Ocular Surface, 7*, 2–6.

Murube, J. (2009c). Basal, reflex, and psycho-emotional tears. *The Ocular Surface, 7*, 60–66.

Nelson, J. K. (2005). *Seeing through tears: Crying and attachment*. New York: Routledge.

Newman, J. D. (2007). Neural circuits underlying crying and cry responding in mammals. *Behavioural Brain Research, 182*, 155–165.

Ostwald, P. (1972). The sounds of infancy. *Developmental Medicine and Child Neurology, 14*, 350–361.

Penbharkkul, S., & Karelitz, S. (1962). Lacrimation in neonatal and early infancy period of premature and full-term infants. *Journal of Pediatrics, 61*, 859–863.

Pennebaker, J. W., Rimé, B., & Blankenship, V. E. (1996). Stereotypes of emotional expressiveness of northerners and southerners: A cross-cultural test of Montesquieu's hypotheses. *Journal of Personality and Social Psychology, 70*, 372–380.

Petitus, P. (1661). *De lacrymis [About tears]*. Paris: Claude Cramoisy.

Picó, A., Gračanin, A., Gadea, M., Boeren, A., Aliño, M., & Vingerhoets, A. J. J. M. (2017). Sincerity, remorse, and punishment: How visible tears impact observers' judgments. Manuscript submitted for publication.

Provine, R. R. (2012). *Curious behavior. Yawning, laughing, hiccupping and beyond*. Cambridge: Belknap Press.

Provine, R. R., Krosnowski, K. A., & Brocato, N. W. (2009). Tearing: Breakthrough in human emotional signaling. *Evolutionary Psychology, 7*, 52–56.

Radcliffe-Brown, A. (1964). *The Andaman Islanders*. New York: Free Press (originally published in 1922).

Read, K. A. (2005). Productive tears: Weeping speech, water, and the underworld in Mexica tradition. In K. C. Patton & J. S. Hawley (Eds.), *Holy tears: Weeping in the religious imagination* (pp. 52–66). Princeton: Princeton University Press.

Reynolds, C. (1924). The biological origin of weeping. *Journal of Neurology, Neurosurgery, and Psychiatry, 5*, 355–358.

Riem, M. M. E., Van IJzendoorn, M. H., De Carli, P., Vingerhoets, A. J. J. M., & Bakermans-Kranenburg, M. J. (2017). Behavioral and neural responses to infant and adult tears: The impact of maternal love withdrawal. *Emotion, 17*(6), 1021–1029.

Rosenblatt, P. C., Walsh, P. R., & Jackson, D. A. (1976). *Grief and mourning in cross-cultural perspective*. New Haven, CT: Human Relations Area Files Press.

Rottenberg, J., & Vingerhoets, A. J. J. M. (2012). Crying: Call for a developmental lifespan approach. *Personality and Social Psychology Compass, 6*, 217–227.

Rottenberg, J., Bylsma, L. M., & Vingerhoets, A. J. J. M. (2008). Is crying beneficial? *Current Directions in Psychological Science, 17*, 400–404.

Schnall, S., Roper, J., & Fessler, D. M. T. (2010). Elevation leads to altruistic behavior. *Psychological Science, 21*, 315–320.

Shariff, A. F., & Tracy, J. L. (2011). What are emotion expressions for? *Current Directions in Psychological Science*, *20*, 395–399.

Simler, K. (2014). Tears. Retrieved from http://www.meltingasphalt.com/tears/.

Simons, G., Bruder, M., van der Lowe, I., & Parkinson, B. (2012). Why try (not) to cry: Intra- and interpersonal motives for crying regulation. *Frontiers in Psychology, 3*, 597.

Singer, P. (2011). *The expanding circle*, revised edition. Princeton: Princeton University Press.

Soltis, J. (2004). The signal functions of early infant crying. *Behavioral and Brain Sciences, 27*, 443–490.

Strayer, F. F., & Trudel, M. (1984). Developmental changes in the nature and function of social dominance among young children. *Ethology and Sociobiology, 5*, 279–295.

Sung, A. D., Collins, M. E., Smith, A. K., Sanders, A. M., Quinn, M. A., Block, S. D., & Arnold, R. M. (2009). Crying: Experiences and attitudes of third-year medical students and interns. *Teaching and Learning in Medicine, 21*, 180–187.

Tan, E. S., & Frijda, N. H. (1999). Sentiment in film viewing. In C. Plantinga & G. M. Smith (Eds.), *Passionate views: Film, cognition, and emotion* (pp. 48–64). Baltimore: Johns Hopkins University Press.

Treacher-Collins, E. (1932). The physiology of weeping. *The British Journal of Ophthalmology, 16*, 1–20.

Urban, G. (1988). Ritual wailing in Amerindian Brazil. *American Anthropologist, 90*, 385–400.

Van de Ven, N., Meijs, M., & Vingerhoets, A. J. J. M. (2016). What emotional tears convey: Tearful individuals are seen as warmer, but also as less competent. *British Journal of Social Psychology, 56*(1), 146–160.

Van Hemert, D., Van de Vijver, F., & Vingerhoets, A. J. J. M. (2011). Culture and crying: Prevalences and gender differences. *Cross-Cultural Research, 45*, 399–431.

Van Kleef, G. A. (2016). *The interpersonal dynamics of emotion*. Cambridge: Cambridge University Press.

Van Wees, H. (1998). A brief history of tears: Gender differentiation in Archaic Greece. In L. Foxhall & J. Salmon (Eds.), *When men were men: Masculinity, power, and identity in Classical antiquity* (pp. 10–53). London: Routledge.

Vingerhoets, A. J. J. M. (2013). *Why only humans weep: Unravelling the mysteries of tears*. Oxford: Oxford University Press.

Vingerhoets, A. J. J. M., & Bylsma, L. M. (2016). The riddle of human emotional crying: A challenge for emotion researchers. *Emotion Review, 8*, 207–217.

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 Assen, M. A. L. M. (2009). Love and tears. Poster presented at the biannual meeting of the International Society for Research on Emotion (ISRE), Leuven, Belgium.

Vingerhoets, A. J. J. M., Van de Ven, N., & Van der Velden, Y. (2016). The social impact of emotional tears. *Motivation and Emotion, 40*, 455–463.

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 adult 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: Tilburg University Press.

Wells, J. C. K. (2003). Parent-offspring conflict theory, signaling of need, and weight gain in early life. *The Quarterly Review of Biology, 78*, 169–202.

Wellenkamp, J. C. (1992). Variation in the social and cultural organization of emotions: The meaning of crying and the importance of compassion in Toraja, Indonesia. In D. D. Frank & V. Gecas (Eds.), *Social perspectives on emotion* (Vol. 1, pp. 189–216). Greenwich: JAI Press.

Worchel, F. F., & Allen, M. A. (1997). Mothers' ability to discriminate cry types in low-birthweight premature and full-term infants. *Children's Health Care, 26*, 183–195.

Zahavi, A. (1977). The cost of honesty (further remarks on the handicap principle). *Journal of Theoretical Biology, 67*, 603–605.

Zeifman, D. M. (2001). An ethological analysis of human infant crying: Answering Tinbergen's four questions. *Developmental Psychobiology, 39*, 265–285.

Zeifman, D. M., & Brown, S. A. (2011). Age-related changes in the signal value of tears. *Evolutionary Psychology, 9*, 313–324.

Asmir Gračanin is a senior research assistant in the Department of Psychology at the University of Rijeka, Croatia. His teaching and research interests encompass evolution and psychophysiology of emotion and related individual differences. He recently spent two years at Tilburg University, The Netherlands, where he conducted numerous experiments and wrote several theoretical papers and book chapters in the field of human emotional crying, which remains in his scientific focus.

Lauren M. Bylsma is an assistant professor and clinical psychologist in the Department of Psychiatry at the University of Pittsburgh. Her research interests broadly encompass understanding affective functioning, including emotional crying, in the context of health and psychopathology, with a focus on depression and depression risk.

Ad Vingerhoets is a research psychologist affiliated with the Department of Medical and Clinical Psychology at Tilburg University, The Netherlands. His research interests and expertise focus on stress, emotions, and quality of life. His research on emotional tears, leisure sickness, and homesickness/nostalgia attracts world-wide media attention.