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Adult Crying: A Model and Review of the Literature

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Abstract

Crying is one of the most powerfully compelling forms of human emotional expression and yet, until recently, crying has received little attention from behavioral scientists. In this article, a model of adult crying is presented that describes the situations and emotions that elicit crying, and characterizes the possible moderating effects of environmental, personal, and cultural factors on crying. Empirical data relevant to the model are summarized and areas in need of further investigation are identified. In addition, the question of whether and how crying may affect mood and health is considered. It is concluded that the literature is full of ungrounded speculation and that research until now has been rather unsystematic and not sufficiently theory driven. Recently available data, however, pave the way for formulating a more comprehensive theoretical framework for generating testable hypotheses about crying.

Crying is a ubiquitous and compelling form of emotional expression. Defined as the secretion of tears in an emotional context, crying also appears to be uniquely human. In spite of this, it is remarkable how little attention the behavioral sciences have paid to this phenomenon. Until recently, very little behavioral and psychobiological research was devoted to adult crying. This is not to say that there has not been speculation about the origin and functions of crying. Scientists from many different backgrounds have wondered about it and have put forth a variety of--unfortunately often untestable--hypotheses about the origins and functions of emotional tears. A systematic testing of most of these theories and hypotheses, if possible, has not yet taken place. Most research until now has not been theory driven, but may best be described as exploratory, descriptive, and unsystematic. Even though our knowledge of crying is incomplete, the time seems ripe for presenting a comprehensive model of adult crying, critically reviewing the extant literature on crying in the light of such a model, identifying the gaps in our knowledge of crying, and putting forth recommendations for future research.

In what follows, we examine the events that elicit adult crying and the emotions that accompany it. We also examine moderating factors that may inhibit or facilitate the shedding of tears. These include sociocultural and demographic factors (including age, gender, role patterns, and cultural background), personality, physical and psychological state, and environmental variables. Our aim is to present a preliminary model of adult crying that specifies the relationships among these various factors and how they influence crying and the experience of crying, integrating the current knowledge.

Because comprehensive reviews of infant crying exist elsewhere (e.g., Lester, 1984) and because our intention is to outline what we know about adult crying, our review focuses almost exclusively on the results of studies with adult samples.

A definition of crying

Crying may be precisely defined as a complex secretomotor response that has as its most important characteristic the shedding of tears from the lacrimal apparatus, without any irritation of the ocular structures and often accompanied by alterations in the muscles of facial expression, vocalizations, and in some cases sobbing, which is the convulsive inhaling and exhaling of air with spasms of the respiratory and truncal muscle groups (Patel, 93). This definition thus excludes the production of tears by irritants. Some authors (e.g., Cornelius, 1981) use the term weeping in preference to crying to differentiate the shedding of emotional tears from mere vocalization. We employ the term crying in the present review to emphasize the possible continuities among infant and non-human primate distress calls and adult crying. Other authors (cf. Williams & Morris, 1996) differentiate among different levels of crying, for instance, watery eyes, flowing tears, or tears plus sobbing. Whether this classification does justice to the phenomenon and/or differentiates between qualitatively different forms of crying remains for the time being an open question.

Theories of Crying

Lay conceptions

Before discussing scientific views of adult crying, it may be helpful to discuss briefly lay conceptions of crying so as to put the more scientific attempt to understand crying in context. Cornelius (1986) collected and analyzed 70 articles on adult crying from popular American and British magazines of the period 1848 to 1985. He found that there was little development in views of crying during this period. The central themes were that crying is unique to humans, that it is good to

cry, and that not crying may seriously endanger one's health. There was, as one might imagine, ample attention paid to gender differences in the sample of articles. A recurrent theme was that women cry more often, for longer periods of time, and more intensely than do men. Remarkably, hardly any attention was paid to the situations that induce crying. Apparently, it was felt that these were common knowledge.

Cornelius (1986) identified only one major development in the past 140 years: there was a clear shift in the rationale given for the advice not to withhold one's tears. Whereas in the mid-1800's this advice was based predominantly on a moral claim ("Those who do not weep are bad"), in the 20th century there was a development from a simple model of emotional catharsis via the psychosomatic hypothesis that unexpressed tension would find a symbolic outlet in somatic disorders to the latest idea that crying prevents the toxification of the body because it helps to remove toxic waste products released when being emotionally upset. One should be aware, however, that these conceptions may be typical only of western societies. Georges (1995) and Wellenkamp (1995) discuss many examples of non-western cultures in which withholding expression rather than disclosure is postulated to be the healthy way of dealing with emotions.

Scientific conceptions

Theories of crying may be classified in many ways, all with their own advantages and disadvantages. For example, theories may be qualified according to their background as ethological, anthropological, psychological, psychoanalytic, or biochemical. Borgquist (1906) was the first to emphasize a global distinction between theories that focus on the signal or communicative function of crying and the effects of crying on the environment, on the one hand, and theories stressing the psycho-

biological aspects of crying and its potential effects for personal physical and mental well-being, on the other hand.

Cornelius (1988) makes a distinction between reductionist theories, in which crying is reduced to its supposed physiological functions (Darwin, 1872; Frey, 1985; Montagu, 1959) and ecological views of shedding tears, which recognize that crying is not merely a response of the lacrimal glands, but rather a response of the whole body, in all its physiological, behavioral, cognitive, and social complexity (cf. Reynolds, 1924). Other theories may be labeled as psychoanalytic (e.g., Heilbrunn, 1955; see also Kottler, 1996; Löfgren, 1966; Sachs, 1973) or psychological/cognitive (e.g., Efran & Spangler, 1979; Labott & Martin, 1988).

Let us start with the reductionist views. Darwin (1872) considered tears as a more or less useless accompaniment to the contraction of the muscles around the eye. This contraction serves a protective function by preventing the facial muscles, especially around the eyes, from becoming too engorged with blood. Tears were thus regarded by Darwin as an exception to the rule that purposeless behavior and body structures will not be maintained during the course of evolution (Cornelius, 1996). On the other hand, Darwin appears to be aware that crying is helpful at least for small children to attract the attention of caregivers, when being in distress. In addition, he mentions that crying may be helpful in bringing relief in much the same way as writhing of the whole body, the grinding of the teeth, and the uttering of the piercing shrieks, all give relief when one is in intense pain (p. 175). Following Darwin's ideas closely, Montagu (1959) hypothesized that crying originated as a protective mechanism preventing a rapid drying out of the mucous membranes of the nose and throat and that tears, which contain the antibacterial enzyme lysozyme, also reduce the risk of contracting upper respiratory infections. In this way, tearing thus contributes to the survival of the species.

A more recent variant of reductionist views has been proposed by the American biochemist Frey (1985), who may be considered to be the pioneer of modern crying research. His focus is on the biochemical aspects of crying which sharply contrasts with many of the (social) psychological models of crying. In his opinion, the main function of crying is the removal of toxic waste products that are released when people are distressed. Frey further postulated that the removal of these substances will have an effect on one's mental state. Crying is thus conceived of as an active excretory process, with tear glands as equivalent to the kidneys in helping to detoxify the body, resulting in a better mood. Murube, Murube and Murube (1999), however, rejects this theory, arguing that (i) the postulated toxic substances have never been identified in emotional tears and (ii), even if such substances were found in tears, their quantities would be negligible, much too small to have any appreciable effects on stress.

Psychoanalysts also have proposed several theories of crying. For example, Heilbrunn (1955) argued that crying symbolized regression to an intrauterine state. He also emphasized the symbolic extension of crying from washing away painful irritants by tears to washing away painful states of the organism. Others (see Kottler, 1996) have regarded crying as a compensatory defense against other internal drives such as the discharge of aggressive or sexual energy (Löfgren, 1966; Sachs, 1973). Also relevant among psychoanalytic theories of crying is the notion that crying serves a kind of hydraulic/overflow process as a "safety valve" (e.g., Breuer & Freud, 1895/1955; Koestler, 1964; Sadoff, 1966). In this case, tears represent the overflowing of emotions that have passed a critical level. In this way, an excessive buildup of emotions is avoided and there is a draining off of energy mobilized during distress.

In a related theory, Bindra (1972) conceptualized tears as reflecting emotions and feelings that cannot be worked off in action, but that can be consummated only in biological processes that result in an overflow of tears. Tears are thus considered

as helping to discharge tension in situations in which an individual is not able to cope effectively.

Crying is further regarded by some as a kind of interaction with the environment, with an emphasis on its communicational aspects. In this way of thinking, tears are seen as powerful signals, which may have many different meanings (Kottler, 1996; Treacher Collins, 1932). As Roes (1990) and Kottler (1996) argue, crying in infants, and perhaps in adults as well, mobilizes help from others in emergencies. Kottler (1996) speculated that crying is uniquely human because of the fact that human development is rather slow and that it therefore takes a long time before humans can take care of themselves. Humans are thus in need of behavior that is extremely powerful to keep caretakers motivated to provide infants food, shelter, and protection. Roes (1990) further suggested that crying may help to inhibit the aggressive impulses of potential aggressors. There is also speculation that this may have to do with the fact that adults look more like babies when they cry. The "kinderschema" has been found in ethology to be a powerful stimulus to strengthen the bond between parent and child and to evoke feelings of tenderness (cf. Eibl-Eibesfeldt, 1997).

Efran and Spangler (1979), in their two-factor theory, propose that crying results from a reappraisal of the factors that induce arousal, leading to a resolution of emotional conflict. Their theory is cognitive in nature because the induction of arousal and recovery are defined in cognitive terms. Arousal is assumed to be the consequence of an attempt to assimilate events that are incongruous with or interrupt schema-based expectations. Recovery is facilitated when there is a psychologically relevant event that leads to the giving up of the original schema and thus renders further assimilation efforts unnecessary. Here, tears are thus considered to be a sign of tension reduction. They indicate the shift from arousal to recovery. Two factors take a central position in this theory: (i) the induction of arousal, which

causes an imbalance in emotional equilibrium; and (ii) an event or cognitive reappraisal facilitating the recovery of emotional equilibrium. Crucial is the transition from arousal to recovery. Tears flow, in particular, in the second phase of this process, i.e., during the phase of recovery or tension reduction. At the moment that the individual feels that the worst is over, crying would be associated with increased parasympathetic activation after initially increased sympathetic arousal. This explanation begs the question as to why tears are associated with parasympathetic arousal.

Labott and Martin (1988) argue that both the two-factor theory and the psychoanalytic overflow theory have their limitations, in particular, because both fail to predict when other responses (such as laughing) will occur. Therefore, they proposed a combination of these two theories, stating, possibly for only some specific emotions, that incongruity and schema-change, when associated with high arousal, will predict most adequately the occurrence of emotional tears.

Frijda (1986) considers crying as a sign of helplessness and powerlessness. In crying, the person wants to surrender and to give up. Central in this view is the notion that crying indicates the person's inability to cope adequately with taxing situations. More or less similar views were voiced as early as 1650 by the British philosopher Thomas Hobbes (see Lutz, 1999). In addition, Crile (1915) and Bindra (1972) also both point to crying as a way to release energy that cannot be worked out behaviorally. Frijda (1986) further pointed to the social interactive aspects of crying. Very often, crying helps to strengthen the mutual bonds between people. Crying may induce sympathy, empathy, and comfort. On the other hand, it may also elicit irritation because crying is sometimes perceived as a form of blackmailing (Frijda, 1997).

Some basic unanswered questions

Crying is one of the first mechanisms that the newborn has in its repertoire of responses for coping with distress (Boukydis, 1985). It is considered to be adaptive because it attracts attention and brings aid, solace, and instrumental support from nearby persons who can diminish the aversive conditions that elicited the crying behavior. Does adult crying also serve such a communicative function? Or would the major function of adult crying be its supposed effects on restoring emotional balance and the facilitation of recovery processes? In other words, what are the basic functions of crying? We propose that crying may be seen as fulfilling different non-mutually-exclusive coping functions. It may be a response that occurs when all attempts to cope have been abandoned. Crying may be employed to arouse social support, and it also may be a way to directly influence one's emotional state, behaviorally or cognitively. Finally, crying may be a way to more or less directly address the source of one's distress. There is no reason to assume that any one instance of crying must be indicative of only one of these forms of coping. Thus, crying may be considered helpful to turn seemingly uncontrollable situations into controllable ones. It is a complex behavior with physiological, behavioral, cognitive, and social aspects, and one should not be surprised if it simultaneously embodies several different kinds of coping.

There is evidence that crying certainly does influence the social environment. However, it has been argued that humans have at their disposal many other verbal and nonverbal behaviors with which to communicate their feelings and desires. Moreover, empirical data indicate that adults often cry when alone (Frey, 1985; Vingerhoets & Becht, 1997; Vingerhoets, Van Geleuken, Van Tilburg, & Van Heck, 1997). Why would people display behavior that is primarily intended to communicate in situations in which no others are present?

One answer might be that solitary adult crying, like the crying of infants, has as its aim drawing others near (D. Zeifman, personal communication, June 9, 1998). Other answers are suggested by Fridlund's (1994) analysis of the sociality of facial expressions of emotion that occur in private. Fridlund argues that the presence of others is "one of the least important criteria for ascertaining the sociality of facial displays" (p. 160). Private emotional displays may be considered social, according to Fridlund, because we may treat ourselves as an audience or another interactant, we may act as if others are present or imagine that they are, we may "forecast" or rehearse interactions with others, and we may treat animals or inanimate objects as interactants (pp. 160-166). What applies to other facial displays of emotion may apply to crying as well.

There is also the question, not unrelated to the first, of the extent to which crying may be considered to be a unitary phenomenon (cf. Cornelius, 1988). Are solitary and social crying different forms of crying in some important sense? Is sobbing fundamentally different from simply getting silent watery eyes, like when being moved? Can the tears of infants be considered the same as those of adults? There are, at present, no unequivocal answers to such questions. However, data collected by Williams and Morris (1996) suggest that there may be at least two different forms of adult crying.

Williams and Morris (1996) applied a principal component analysis to the answers the participants in their study of crying among Israeli and English adults gave to seven questions about their experience of crying. Participants were asked how often and intense their crying is and how long their crying episodes typically are. Participants further indicated whether or not they could make themselves cry and whether they could stop themselves from crying once they had begun. Finally, information was collected on episodes in which participants felt like crying but did not. The results of their analysis suggested two distinct types of crying. The first

involves crying that is intense, long lasting, and difficult to stop. This form of crying preempts ongoing activities and may have a strong impact on the social environment. The eliciting situations of this form of crying may generally be classified as strongly negative situations. The second kind of crying is more diverse in form and also more controllable. This kind of crying may or may not strongly interfere with ongoing activities. The primary focus is on the situation rather than on crying itself. Examples are crying when watching a sad movie, when being touched, or experiencing tender feelings. This kind of crying seems to be most prevalent among adults (Williams & Morris, 1996). The validity of this typology of crying is, as yet, untested. It does, however, suggest one way in which examination of the question of the existence of different forms of crying might proceed. It also suggests that the answer to the question about the extent to which crying is communicative may depend on what form of crying is involved.

In considering whether or not crying may have evolved to communicate distress, the question of whether tears can be used to manipulate others is relevant. Even in early writings on this topic, there were disagreements about the extent to which tears are voluntary and under direct control of the will rather than, as argued by Mélinand (1902), semi-voluntary. Mélinand, following Schopenhauer, considered tears as an expression of pity, more specifically, pity for oneself. She conceived of tears as a kind of language and a means of expression resulting in sympathy, pity, and aid from others. In contrast, Borgquist (1906) argued that tears are not under direct control of the will. However, he did recognize the effectiveness of tears in evoking sympathy and comfort. Cornelius (1981, 1997) also emphasized the social aspects of crying and challenged the commonly held assumption that crying is a completely involuntary activity. He argued that, in some instances, crying should be regarded as instrumental, although not consciously manipulative. Furthermore, he stated that the often presumed cathartic effects of crying are the consequence of

positive changes in the situation or relationships with others that crying helps to bring about. Buss (1992), in his study on manipulation in close relationships showed that women in particular may use crying purposefully to manipulate others. There is no reason why crying should not be sensitive to conditioning processes, just like any other behavior. Moreover, in the literature there are examples of therapeutic interventions both to increase (Linton, 1985) and to decrease (Field, 1970; Redd, 1982; Redd & Rusch, 1985; Rimm, 1967; Tasto & Chesney, 1977) crying behavior.

Because the literature is full of unproved speculations about crying and research on the phenomenon is rather unsystematic and not theory driven, the time seems ripe for a more systematic and in-depth study of crying. There is also need for theories and models that stimulate the formulation of testable hypotheses. With the present contribution we hope to have made a very first beginning of the formulation of a model that may be helpful in guiding the design of future studies. Further, we want to emphasize the criticism we have put forth about the measures used in studies of crying and the lack of precision in the operationalization of variables.

To summarize, it is clear that there is a wide variety of opinions on the precise nature and function of crying. However, what is lacking is an adequate model that may be helpful to predict which specific environmental and personal conditions facilitate or inhibit the shedding of tears. Some of the interpretations presented above are basically untestable, but others invite the design of studies that may yield answers to some questions. What is needed is a model of crying that specifies more precisely the relationships among the various aspects and functions of crying. In the next section, we review existing research on crying. Subsequently we will present a preliminary model, in which we try to integrate what is known until now. In addition, the model may be helpful to formulate testable hypotheses.

A Model of Adult Crying

We envision crying as the result of the interaction of the complex series of psychobiological, cognitive, and social processes illustrated in Figure 1. We begin, as others have done in more general models of emotion (e.g., Frijda, 1988), with the assumption that emotions are set in motion by the ways in which individuals appraise events in their environment. Appraisal refers to the process of judging the personal significance of events for good or ill (Arnold, 1960). Appraisals are a function of objective physical and social features of situations as well as of features of the individual. The latter include, among other things, his/her current emotional state, goals as they are relevant to the situation, previous experiences in similar situations, as well as evaluations of the ability to cope with the situation (secondary appraisal). Emotions are differentiated by the patterns of appraisal that initiate them (Frijda, Kuipers, & Ter Schure, 1989). For example, injustice may evoke feelings of anger, loss, and sadness, whereas threat may induce fear.

Insert Figure 1 about here.

Appraisals thus put into motion what might be called emotion programs (Levenson, 1994) or emotion syndromes (Averill, 1980), that is, patterned, biologically and socially based collections of responses that include physiological, expressive, experiential, and behavioral components (see Cornelius, 1996), each of which may have functional significance (cf. Levenson, 1996). These components have been characterized by Gross and Muñoz (1995) and others as response tendencies to highlight the fact that they may be modified or modulated (e.g., exaggerated, diminished, or even entirely inhibited) before they are expressed as observable behavior, emotion self-reports, or physiological changes. Such modulation may involve a variety of physiological, situational, and personal factors. Because of this,

as Averill (1980) has argued, the linkages among the various components of emotion in humans tend to be loose.

We see crying as a physiological/expressive response that may be elicited by a number of different appraisals (e.g., that a situation is threatening, that one has no possibilities to deal with it) and that is associated with a number of different situations (e.g., loss/separation, rejection, reunion) and emotional states (most notably, sadness, powerlessness, pain, but also happiness). Psychophysiologicaly, crying is associated with increased parasympathetic and sympathetic arousal. Whether or not a person will cry when exposed to a particular emotional stimulus is further moderated by a number of personal (e.g., self-monitoring status, physical state, personality) and sociodemographic factors (e.g., gender, age) as well as a variety of situational factors (e.g., the presence of others who are crying, the salience of social norms concerning crying). Note that these moderating factors may also determine whether or not an individual will be confronted with certain emotional situations. For example, social rules require that we attend funerals of particular persons. These same factors also may influence our appraisal processes, which may explain individual differences in crying. One may expect, for example, that personality is particularly important in explaining why people do not cry in dramatic situations or why they do cry in emotionally weak situations. Display rules or the reaction of the social environment may also be important as regulators of our emotional behavior. The act of crying subsequently may have an impact on psychobiological processes in the crying individual him/herself and may facilitate physiological and psychological recovery, when in distress by as yet unknown mechanisms (such as the release of endorphins?). At the same time crying may elicit particular reactions from the social environment of both a positive and negative nature. Crying, by eliciting particular reactions from others, may alter the objective characteristics of the situation (e.g., by eliciting sympathy from an antagonist during

an argument). In addition, crying may have direct effects on both primary and secondary appraisal (e.g., when crying individuals realize how upset they are). Finally, comforting behaviors of others and other forms of emotional support may directly influence one's emotional state.

In short, crying is an emotional response that needs to be conceptualized in much the same way as emotions in general. This raises the crucial question which specific elements of crying makes it different from other expressions of emotion. Two aspects probably stand out in this regard: its association with many different emotions (although inability to act behaviorally may be a common element) and the fact that it is clearly observable, which puts it at the same level as laughing and swearing (cf. Montagu, 1942).

In what follows, we review evidence from studies of crying and related phenomena that bear on this model, highlighting along the way those places where there are gaps in our knowledge of crying. Following our review, we focus on the relationship between crying and health, presenting five models that we believe may help us understand how and why crying may be related to health. First, however, we will briefly address some issues concerning the measurement of crying.

Assessment of crying

As may be clear from the above present overview, crying research focuses both on the determinants and predisposing factors of crying as well as on the consequences of crying. In research on the latter, crying is induced in the laboratory, mostly by exposure to sad films or recall of a recent crying episode. It is left to the participant to determine whether (s)he has cried at a certain moment. We are only aware of one study in which an attempt was made to more objectively establish crying; namely, by measuring lacrimal flow (Delp & Sackeim, 1987).

In studies on the relationship between crying frequency and gender, personality, or health, a number of different questionnaires have been used. We feel that it is important to evaluate these measures critically, because there appears to be no clear consensus as to what crying frequency means. A close inspection of some of the questionnaires employed in crying research (e.g. De Fruyt, 1997; Vingerhoets, Van den Berg, Kortekaas, Van Heck, & Croon, 1993; Williams, 1982) reveals that they assessed crying proneness rather than crying frequency. Therefore, we propose to reserve the term crying frequency for estimates of the actual number of crying episodes within a certain time period, whereas crying proneness refers to how likely it is that an individual will cry in a (hypothetical) situation. The difference between both concepts is most clear if one realizes that people may avoid situations that very likely make them cry. In other words, for some people it may be very unlikely that they cry in a situation that has a high potential to elicit tears.

The literature further indicates that estimates of crying frequency differ considerably when varying the time period of the estimate. For example, Williams and Morris (1996) asked the participants to estimate how frequently they had cried in the past year. These estimates were considerably lower than the sums of the last 12 monthly crying estimates, which were more in correspondence to the results of concurrent studies in which crying diaries were kept (e.g. Frey, Hoffman-Ahern, Johnson, Lykken, & Tuason, 1983). Of further relevance is that there are some preliminary reports showing that respondents who score high on crying proneness measures are indeed more likely cry when being exposed to emotional films (Campbell et al., 1999; Hastrup, Baker, Kraemer, Bornstein, & Trezza (in press)). In addition, Williams (1982) found no association between self-reported crying frequency and scores on a Lie scale, which also appears to support the validity of self-report data. On the other hand, Hastrup et al. (in press) point to a discrepancy between the self-report data of children and observational data.

In conclusion, we would propose a more precise use of the terms crying frequency and crying proneness. To illustrate this issue: In a pilot study with monozygotic and dizygotic twins, Lensvelt and Vingerhoets (unpublished data) distinguished between crying frequency and crying proneness, as described above, and showed a marked discrepancy between these two variables. Actual crying frequency appeared to be to a large extent environmentally determined, whereas crying proneness proved to be more genetically based. Therefore, we strongly recommend to evaluate existing measures critically and to come to standardized measures making the comparability among studies more easy.

Review of Existing Evidence

Physiological/psychobiological aspects of crying

The lacrimal system is under the control of both the sympathetic (SNS) and the parasympathetic nervous system (PNS). The main lacrimal gland is innervated by nerve fibers from the fifth cranial (trigeminal) nerve, the seventh cranial (facial) nerve, and the cervical sympathetic chain, whereas the accessory lacrimal glands appear to be devoid of any outside nerve supply. Stimulation of the lacrimal nucleus in the brain stem, the putative parasympathetic center for the lacrimal gland, results in increased tear production. This lacrimal nucleus has connections with several other brain structures such as the frontal cortex, the basal ganglia, the thalamus, and, especially important with respect to the biological aspects of stress and emotions, the hypothalamus (Botelho, 1964).

Even though the lacrimal gland is innervated by both the SNS and PNS, it is the PNS that is responsible for the shedding of tears (Botelho, 1964). As has been outlined previously (Vingerhoets, 1985; Vingerhoets & Van Heck, 1993), there is accumulating evidence showing that the PNS is especially active when persons experience emotions and moods characterized by passivity and helplessness. Vingerhoets and Van Heck, elaborating on the work of Engel (1978), Henry and Stephens (1976) and Kling (1933), argued that there might be "passive" and "active" forms of fear and anger with different psychobiological reaction patterns. Vingerhoets et al. (1997) observed that women indeed often reported a mix of emotional feeling when they cry, with powerlessness as a central element.

Research on the composition of tears indicates that they have relatively high concentrations of the hormones prolactin, adrenocorticotrophic hormone (ACTH), and leucine-enkephalin (Frey, 1985). In addition, they contain lysozyme, several proteins, and remarkably high concentrations of manganese (Frey, DeSota-Johnson, & Hoffman, 1981). ACTH is well-known as a stress hormone with important effects

on the release of other hormones, in particular cortisol, and on behavior. Leucine-enkephalin, among others, affects the release of Substance P, which has been hypothesized to play a role in pain perception (cf. Sakurada, Sakurada, Tan-No, & Kisara, 1997). Frey et al. (1981) compared the composition of irritant tears and emotional tears and found differences in albumen content, although it is rather difficult to interpret these findings and to give the obtained differences any significant physiological or psychological meaning. Of course, it remains to be established whether the act of crying influences the composition of the tears or whether these altered concentrations of substances in tears result from the exposure to emotional stimuli.

Tears and tear glands contain high concentrations of prolactin. Frey (1985) postulated a relationship between crying propensity and serum prolactin levels. Prolactin is particularly important in women. This hormone influences the menstrual cycle and promotes breast development and postpartal lactation. From puberty onwards, women have higher plasma concentrations than do men. According to Frey (1985), the following observations support his contention that prolactin lowers the threshold of crying: (i) gender differences in crying more or less parallel differences in plasma prolactin levels; (ii) the administration of drugs that lower prolactin levels reduces pathological crying; and (iii) injections of prolactin in eider ducks stimulates secretions of the supraorbital salt gland, which is similar in location, innervation and, histology to the human lacrimal gland. Moreover, it has been reported that the circadian fluctuations of prolactin correspond to the changes in salt gland secretions in a species of marine ducks (cf. Frey, 1985, p. 52).

Additional evidence for the association of prolactin and crying include the observation that pregnant women have been reported to be less emotionally stable and more prone to cry during specific periods of their pregnancy than non-pregnant women and that the maternity blues, in particular characterized by a low threshold

for crying, typically occurs when plasma prolactin levels are extremely high (Lutjens, 1998). Moreover, it is tempting to speculate that the occasionally reported crying spells of women after an orgasm, are also related to the accompanying increase in prolactin (Exton, Bindert, Krüger, Scheller, Hartman, & Schledlowski, 1999). Of further relevance in this respect is the evidence put forth by Theorell (1992) suggesting that prolactin must be considered as a hormone reflecting passivity and powerlessness. In addition, Jacobs, Brown, Mason, Wahby, Kasl, and Ostfeld (1986) reported increased prolactin levels in bereaved women. Thus, there are several good reasons for postulating an association between prolactin and crying proneness, although hardly any data available in which prolactin levels are actually assayed. Probably most close to it is a pilot study by Vingerhoets, Assies, and Poppelaars (1992) in which the crying tendency of hyperprolactinemic women and healthy controls was compared. This study failed to find any differences. However, it should be emphasized that the prolactin levels in these patients, although sufficiently elevated to produce menstrual cycle disturbances, were rather low as compared to levels found in pregnancy, after delivery, or in patients with prolactinoma.

Why do people cry?

Patterns of appraisal and emotions associated with crying. There are several different approaches to the question of why people cry. In some cases, the focus is on the emotions and feelings that elicit crying (e.g., Borgquist, 1906; Bindra, 1972), whereas other investigations have focused on the situations associated with crying (Frey et al., 1983; Vingerhoets et al., 1997). There are also examples where no clear distinction is made between situations and emotions (e.g., Koestler, 1964; Lund, 1930; Young, 1937). Finally, there are studies (e.g. Becht & Vingerhoets, 1997; Williams & Morris, 1996), in which participants have been asked to rate a list of

possible crying-inducing events and/or moods or emotions on the extent to which they lead them to cry. In other investigations (e.g. Vingerhoets et al, 1997; Vingerhoets & Becht, 1997), participants have been requested to recall their most recent crying episode or to record such episodes in a diary.

If participants are asked to indicate the kind of situations in which they are most likely to cry, there is a strong correspondence in findings: the death of intimates, broken love relationships, and sad movies or television programs rank highest. Among positive situations, weddings, music and reunions occupy the top positions (e.g. Morris & Williams, 1996). However, when participants are requested to report on their last crying episode, a different picture emerges because many of the situations that most likely make people cry generally have low base rates. For example, it is unlikely that the last time a person has cried was because an intimate has passed away, since that is not an everyday event. In such studies, conflicts, being rejected, and personal inadequacy are frequently cited by participants as situations in which they have recently cried. Remarkably, physical pain is rarely mentioned.

Borgquist (1906) in his seminal but rather unsystematic study among students identified the following three types of situations in which crying occurs: (i) grief or sadness, (ii) anger, and (iii) joy. He also pointed out that sympathy and fear often accompany crying, as do physical states like nervousness, fatigue, and pain.

Young (1937) collected 1206 reports of crying and laughing episodes from 240 college students. He classified the reasons for crying as follows: (i) disappointment or discouragement, (ii) lowered self-esteem and sense of personal inadequacy, (iii) unhappy mood, (iv) organic state, (v) special events, and (vi) laughter to the point of tears. He noted that whereas some of the conditions are organic in nature (e.g., fatigue, nervousness, headaches, illness, bodily injuries), the environmental causes of crying were almost uniquely social. In particular, actions, words, or attitudes of others were identified as the most important triggers.

Koestler (1964) listed as causes of crying in adults raptness, mourning, relief, sympathy, and self-pity. Infants and children, according to Koestler, are more likely to cry out of pain or hunger. Bindra (1972) concluded from his study of reasons for crying in a small sample of college students that elation, dejection, and anguish were the emotional states most often associated with crying. He also pointed to the importance of predisposing organismic conditions and both positive and negative triggering events of a wide variety.

Based on diary data obtained from 331 participants during a thirty-day period, Frey (1985) concluded that crying often occurs in social situations (40%), which is a rather broad category including both positive (e.g., reunion, weddings) and negative events (e.g., conflicts). He also found that people often cry when reading books or watching movies or documentary reports.

Vingerhoets et al. (1997) conducted a more detailed analysis of the context of crying in a female sample and came to the following conclusions. First, women cry in response to discrete emotional events, but also sometimes without any clear external trigger when reflecting on their lives or situations. Weak and neutral stimuli may evoke strong memories to traumatic or very emotional events that induce crying. Second, the inducing situations are often conflicts, personal inadequacy, and loss events. The self-reported emotions in this study were often a blend of two, three or even four or more emotions, often accompanied by feelings of powerlessness. Women often experienced sadness and powerlessness, anger and powerlessness, frustration and fear combined with powerlessness. In a recent study, Becht and Vingerhoets (1997) obtained similar results, although powerlessness, while still very important, was reported less frequently. There were also important gender differences in the latter study, with men reporting relatively more positive events and emotions, and also fewer conflicts, but more loss experiences than women.

There thus have been a number of authors who have, more or less systematically, collected data on situations in which people report crying and who have tried to categorize the situations associated with crying. Problems encountered when trying to categorize these events have to do with, among other things, the fact that the crying response sometimes may be suspended and delayed until a more appropriate moment or to a later time when one discusses the situation with an intimate. Moreover, as already said before, in some studies, the focus has been on emotions that elicit crying. We feel that a serious problem with the latter approach is that emotions are seldom experienced in a pure form. Another problem is that it is not always easy to differentiate between emotions and events, for instance, when people report states like homesickness, loneliness, or feeling powerless, humiliated, or rejected. Very often, it is a blend of feelings that elicit the crying response.

To summarize, it is not easy to come to an adequate classification of the events that trigger crying. Data collected by Vingerhoets et al. (1997) make it clear that there are a number of additional moderating factors that codetermine whether or not tears will be shed. Obviously, we need to learn much more about the interplay of different factors that are associated with crying and elicit tears.

The temporal and ecological context of crying. Vingerhoets et al. (1997) and Becht and Vingerhoets (1997) established that, in the majority of the cases, people cry at home, with no one or just one other person present, corroborating results from previous studies (e.g., Frey, 1985; Lombardo, Cretser, Lombardo, & Mathis, 1983).

Frey (1985) reported a dramatic increase in crying frequency among women between 7 P.M. and 10 P.M., whereas no significant variations were detected between 9 A.M. and 7 P.M. Vingerhoets et al. (1997) and Becht and Vingerhoets (1997) substantiated these findings and demonstrated further that the propensity to cry shows a gradual increase between 4.00 AM and 11.00 PM. There are several

factors that may explain this observation: First, the threshold for crying may be low because one may feel tired and because one feels safe at home with no strangers present. In addition, there might be more emotional stimulation at this time, for example, conflicts with partners and children, but also known powerful stimuli for tears such as television films and reports. In addition, being alone or lying in bed may be good opportunities to reflect on emotional events that have happened recently or on one's general life situation. However, further (quasi)experimental studies should be designed to obtain a better insight into the precise nature of this phenomenon and the relative influence from external and internal factors on the temporal and ecological context of crying.

The social context of crying. Although research indicates that people most often cry when they are alone, there are also many occasions in which individuals cry in social situations (Vingerhoets & Becht, 1997). The social context, that is, the mere presence of others, but also their reactions to one's crying in the form of disapproval and emotional support, may be expected to have a strong influence on crying and the experience of crying. However, in spite of the obvious power of the situation to shape emotional experiences and expressions, very few studies have systematically investigated this important variable. Vingerhoets, Van Tilburg, Boelhouwer and Van Heck (in press) argue that the presence of others may either facilitate or inhibit crying behavior. Tears may be withheld because one feels ashamed or because one does not want to upset others (e.g. children) through one's tears. On the other hand, the presence of other crying people may bring one to tears ('emotional contagion'; see Hatfield, Cacioppo, & Rapson, 1994) or display rules or social norms may prescribe crying in a particular context such as a funeral. Below, we summarize some relevant experimental studies.

Cretser, Lombardo, Lombardo, and Mathis (1982) examined general social attitudes and personal views toward men and women who cry. Men and women did not differ in their personal views of crying women, but women were more positive and reported being more likely to help and empathize than were men with a man who cried.

In a study by Jesser (1982), it was also found that the crying of women resulted in more positive consequences than did the crying of men. Women were also more supportive of the crying of others than were men. The latter were more likely to be confused and irritated and inclined to neglect the crying person. Both men and women reported that they cry more easily in the presence of women.

Interview data collected by Plas and Hoover-Dempsey (1988) suggest that, while crying in an intimate context might be acceptable, it may result in embarrassment, helplessness and loss of control when it occurs to women on the job.

Labott, Martin, Eason, and Berkey (1991) exposed participants to a movie in the presence of a confederate who cried, laughed, or expressed no emotion. Contrary to the findings of Cretser et al. (1982), their results indicated that men were liked best when they cried, and women when they did not. Criers were not regarded as more feminine, but rather, as more depressed and emotional. Labott et al. concluded that gender role expectations of emotional expression, especially crying, have changed in the last decades.

Hill and Martin (1997), in a laboratory study in which participants were exposed to the apparent film-induced crying of a confederate under a variety of experimental conditions, found that crying confederates (in this study, always women) elicited greater sympathy than did non-crying confederates. Consistent with Labott et al.'s (1991) findings, confederates who cried were not evaluated more positively than non-crying confederates. As part of their experimental manipulations, Hill and Martin (1997) placed participants in a situation in which it

was conveyed to them that emotional expression or emotional restraint reflected support and empathy for the crying confederate. They found that participants cried longer and more intensely in the expression condition. The investigators interpreted these findings as indicating that crying may communicate emotional support and empathy in some situations.

The results of Hill and Martin's (1997) study suggest that crying by others may be an important elicitor of crying, depending on the context in which it occurs. Labott et al. (1991) expected to find what they called "contagious crying" but did not. Unlike Labott et al., Hill and Martin explicitly told their participants, before they witnessed the crying, that the confederate was depressed. It may be that contagious crying requires that the tears of the other be interpreted in a particular manner. This is an area obviously in need of further investigation. One should further be aware that the appraisal of crying men may have undergone a substantial change in the past two decades, as suggested by Kottler (1996).

Moderating factors

Sociodemographic variables. Under this heading we review studies on the relationship between crying and age, gender, role, and cultural background.

As far as age is concerned, little systematic data have been collected, although it has been suggested that crying decreases with age (Borgquist, 1906; Williams & Morris, 1996). Gender differences in crying, however, are not usually found in babies and newborns (Vingerhoets & Scheirs, 2000) and have been suggested not to occur until the age of 13 (cf. Frey, 1985). It has further been reported that tender situations are more important triggers of tears in older persons (Williams & Morris, 1996).

Gender differences in crying are reported very consistently (see Vingerhoets & Scheirs, 2000 for a review). Women cry more frequently, more intensely, and for a longer time than do men. This is also the perception of 90% of the general

population. The way crying is perceived by women and men who shed tears frequently is rather similar, suggesting that the appraisal of crying is more dependent on crying propensity than on gender per se. Women in Bindra's (1972) study reported longer crying episodes than did men. In contrast, both Frey et al., (1983) and Pitts and Martin (1989), using crying diaries, failed to report gender differences in crying duration.

Concerning the direct causes of crying, studies by Kraemer and Hastrup (1986), Williams (1982), and Lombardo et al. (1983), suggest that there are no gender differences. For instance, Lombardo et al. (1983) asked participants to indicate their crying propensity for 20 possible triggers including the death of beloved persons, broken relationships, sad movies, as well as psychological states like feelings of helplessness, loneliness, anxiety, and disappointment. Women scored higher on all items, but there were few significant differences between men and women. This is in line with the results of Becht and Vingerhoets (1997), who presented participants with a list similar to Lombardo's, although more extensive.

However, when comparing the actual situations in which people cried most recently, men and women do differ. According to Bindra (1972), men cry relatively more often for positive reasons and sadness, whereas in women, anxiety, fear and suffering play a more central role. Bindra also showed that women cry more often when feeling angry, whereas men tend to report more positive events, such as reading or writing poetry or listening to music as causes of their crying (cf. Becht & Vingerhoets, 1997; Lombardo et al., 1983).

Williams and Morris (1996) compared the crying behavior of English and Israeli university students and faculty. In addition to revealing some interesting cultural differences in the experience of crying, this study yielded some important gender differences. It was found that women cried more often in conflict situations, with respect to problems at work, and in situations inducing anger. Men rarely cried

for these kinds of reasons. For men, tender situations stimulated tears in them as easily as they did for women. Preliminary data (cf. Becht and Vingerhoets, 1997) point in the same direction and once more confirm the picture that women cry in particular in conflict and loss situations. Loss is also an important reason for men to cry. Moreover, men cry relatively more frequently for positive reasons. Recent research in Malaysia (Joseph, 1996) also yielded rather similar findings. Lombardo et al.'s (1983) data also revealed that both men and women cry most often when alone. The largest differences in crying frequency between men and women in Lombardo et al.'s study were reported with respect to the proneness to cry in the company of a male friend. This is a situation in which women appear to cry considerably more often than do men.

Ross and Mirowsky's (1984) findings suggested the importance of adherence to traditional gender role patterns for crying behavior in men. Men in more traditional roles appeared to cry less frequently than those who defined their gender role more flexibly. The willingness to cry when feeling sad is high in women, intermediate in non-traditional men, and low in traditional men. Since there is often a connection between educational level, socio-economic status and less traditional role patterns, one may expect that more highly educated men will cry more often. Interesting in this respect are the comments by Kottler (1996), who argued that a reverse development can be seen in women in higher status occupations, who, according to this author, are less prone to cry than women in general. Kottler, as Plas and Hoover-Dempsey (1988) have done, suggested that one's professional context may have a strong influence on whether or not one cries. He pointed out that therapists and nurses are professionals who cry a lot, whereas engineers, stockbrokers, soldiers, and doctors rarely cry. However, it is not clear to what extent these conclusions are based on systematic investigations. In conclusion, it may be

that research findings may be very much dependent on the research methods employed and the specific population studied.

Lombardo et al. (1983) reported gender differences in the effects of crying on mood. Women indicated more physical and psychological changes (both positive, such as feeling more relieved and relaxed, and negative, like being tired or feeling ashamed) than did men. Peter, Vingerhoets, and Van Heck (in press), in contrast, failed to find any gender differences in the effects of crying on mood. Ross and Mirowsky (1984), reported a stronger association between sadness and crying in women.

The only study in which no self-report data were obtained, but more objective measures of lacrimal flow were (Delp & Sackheim, 1987), also showed more crying for the female participants in response to an experimental mood manipulation.

To summarize, at least according to their self-reports women appear to cry more often, more intensely, and for longer periods of time than do men. There are also gender differences in the determinants of crying. Women cry more easily in conflict situations and when feeling angry, while men cry relatively more often for positive reasons and in loss situations. It remains to be established to what extent these differences are evolutionary and/or biologically based (e.g., due to the differences in prolactin or differences in brain structures involved in emotional expression; see Kottler, 1996) or result from different socialization processes (Brody, 2000; Bronstein, Briones, Brooks, & Cowan, 1996; Jansz, 2000). It should be kept in mind, however, that in terms of the context and subjective experience of crying, there is a remarkable correspondence between the crying of men and women. First of all, however, we need observational data which might validate these self-report data.

The influence of culture. Until now little systematic research has been conducted that provides insight into cultural differences in crying. Borgquist (1906)

stated that crying is a universal human phenomenon. According to him, differences in crying behavior are due to parental rearing practices, specific cultural influences, and display rules, rather than being biologically determined. He based his view on data obtained via ethnologists and missionaries. Szabo and Frey (1991) conducted a crying diary study among Hungarian and US students and found that Hungarians (both men and women) cried significantly less often than North Americans: monthly frequencies of crying were 0.7 and 3.1 for the Hungarian men and women and 1.4 and 5.3 for American men and women, respectively. Williams and Morris (1996) found remarkable differences in self-reported annual crying frequency estimates between their British and Israeli samples. These estimates ranged from 4.8 (Israeli men) to 31.7 (English women). Corresponding figures for the English men and Israeli women were 8.4 and 17.4, respectively. These figures are considerably lower than the international data obtained by Becht and Vingerhoets (1997), who asked participants to estimate their crying frequency in the past four weeks: mean estimates were 1.1 for men and 2.8 for women. Differences obtained by Williams and Morris were attributed to the fact that all of the Israeli participants had served in the army. It is interesting that Kottler (1996), following Darwin (1872), specifically mentioned these populations and argued that the Israeli generally are more prone to cry.

Recent data collected as part of the International Study on Adult Crying (ISAC; Vingerhoets & Becht, 1997) also revealed significant differences among the cultures studied. Most crying was reported by Turkish, Chilean, and North American female students and Italian, North American, and Austrian male students. Low frequencies were reported by the samples from Peru, Bulgaria, Spain (for men) and Nigeria (for women) (Vingerhoets & Becht, 1997). It is tempting to speculate that cultural display rules might be more rigid for crying than for any other emotional expressions because it is an observable behavior associated with negative emotions.

The influence of personality. The personality attributes that have been found to influence crying propensity are empathy, extraversion, ego-strength, femininity, and self-monitoring. All of these show positive associations with self-reported "crying frequency" or, more precisely "crying proneness" (Choti, Marston, Holston, & Hart, 1986; De Fruyt, 1997; Williams, 1982). Vingerhoets et al. (1993) examined the relationship between crying and personality attributes measured by the Dutch Personality Inventory (NPV; Luteijn, Starren, & Van Dijk, 1985), temperament variables assessed by the Pavlov Temperament Survey (PTS; Strelau, Angleitner, Bantelmann, & Ruch, 1990), and alexithymia, applying the Amsterdam Alexithymia Scale (AAS; Bermond, 1991). As expected, for men as well as women, positive associations were found between neuroticism and crying, whereas alexithymia and self-reported crying proneness were negatively related. For women, negative associations were also found between crying propensity and two temperament variables, strength of excitation and strength of inhibition. Multiple regression analysis indicated that self-esteem acted as a suppressor variable. In particular, the rare combination of high neuroticism and high self-esteem predicted crying. It remains to be established, of course, whether individuals with high self-esteem actually cry more often or it is less threatening for them to admit that they cry now and then.

In a second sample, consisting of only women, Vingerhoets et al. (1993) explored the relationships among crying proneness, alexithymia and coping, applying the Ways of Coping Checklist (WCC; Folkman, Lazarus, Dunkel-Schetter, DeLongis, & Gruen, 1986). The results corroborated the negative association with alexithymia in the first sample. In addition, significant correlations were found between crying proneness and four coping strategies: Self-blame, Daydreaming and Fantasizing, Expression of Emotions/Seeking Social Support (all positive), and

Distancing (negative). In a regression analysis, 22% of the variance in crying was explained, with Distancing and Alexithymia as significant predictors.

Recently, De Fruyt (1997) and Peter et al. (in press) confirmed the previously established association between neuroticism (or, more precisely, its opposite, stability) and crying proneness. These investigators distinguished between crying elicited by negative events or feelings and crying elicited by positive events and/or emotions. The negative association between emotional stability and crying propensity appears to hold more strongly for crying for negative reasons. De Fruyt further reported a positive association between extraversion and mood change after crying. Extraverts generally felt better after a crying episode. Peter et al., however, failed to replicate this relationship.

A study by Schlosser (cited in Goldberg, 1987) revealed a negative association between hardiness and crying proneness in women. This is to be expected given the strong indications that hardiness merely reflects the absence of neuroticism (Mowinski-Jennings & Staggers, 1994). Hardy women further reported that, when confronted with stressful encounters, crying made them feel even more depressed. In contrast, women who reported that they cried frequently indicated they often felt better after a crying episode.

Most interesting are the data of Unterberg (1998), who studied crying in a sample of 481 adolescents. It appeared that the sexes also differed significantly in empathy and that the sex differences in crying proneness were no longer significant, when empathy was taken into account.

Finally, self-monitoring status may be a crucial variable in understanding the effects of the situation on crying. Mattutini and Cornelius (1997), found that high self-monitors, who are generally thought of as being highly sensitive to situational cues (Snyder, 1974), had significantly more control over whether or not they began crying in a particular situation than did low self-monitors. High and low self-moni-

tors did not differ, however, in whether or not they could stop themselves once they had started crying.

In conclusion, there is increasing evidence that personality is an important factor in determining whether or not an individual will cry in a specific situation and as a determinant of general crying proneness. The available evidence indicate moderate relationships between personality and different crying measures. Unfortunately, this research fails to reflect a systematic, theoretically driven approach aimed at unraveling the intricate associations between personality and crying. A major step forward could be made when studies could be framed in a model of individual differences in emotion regulation.

Recently, such a model has been proposed by making a distinction between two major forms of emotion-regulation, namely antecedent-focused emotion regulation and response-focused emotion regulation (Gross & Muñoz, 1995; Gross, 1998). This model suggests that emotions may be regulated either by (i) manipulating the input of the system via situation selection, situation modification, cognitive reappraisal and attentional strategies such as distraction or rumination, or by (ii) manipulating the output, applying strategies that intensify, diminish, prolong, or curtail ongoing emotional experience, expression or physiological responding. An alternative recent model has been proposed by Kennedy-Moore, Greenberg, and Wortman (1991; see also Kennedy-Moore & Watson, 1999). This model provides a systematic way of thinking about the process of emotional (non)expression. Within this framework, can directly result from initial prereflective reactions, bypassing cognitive evaluative steps, or it can reflect an expressive style that manifests itself at different points in the process of emotional expression, *viz.* conscious perception of the affective reaction (e.g., crying), the labeling and interpretation of this affective response, the evaluation of crying as acceptable or not in terms of beliefs and goals, and finally, at the level of the social context for expression. By taking into account

individual or group differences in these ways of regulating emotions, more systematic research can be conducted regarding links between (groups of) individuals and crying. We further agree with Keltner (1996) that personality will exert its influence in particular in strong emotional situations, when tears are withheld, and in weak emotional settings, when one lets one's tears flow.

Physical and psychological state variables. Although systematic data are not available, some accounts of crying episodes suggest that being tired and deprived of sleep (cf. Wagner, Hexel, Bauer & Kropiunigg, 1997) lowers the threshold of crying. In addition, recent research suggests that women may sometimes regulate their moods with the selection of certain films or TV-programs (Helregel & Weaver, 1989), indicating that they may be sometimes more in the mood for crying than at other times. It has been suggested that there might be a relationship with menstrual cycle and hormonal fluctuations. Emotional lability and crying have been associated with particular phases of the menstrual cycle, pregnancy, and the post-partum period (Eugster, Horsten & Vingerhoets, in press; Lutjens, 1998).

Frey (1985) asked 85 women to record their crying episodes and related these to the phase of their menstrual cycle. The results revealed three consistent peaks in crying frequency. Increased crying propensity was observed four to six days before the onset of menstruation, three to five days after the onset of menstruation, and around ovulation. In contrast, Horsten, Becht, and Vingerhoets (1997), applying a retrospective approach, found a self-reported increase in crying tendency from the seventh day before menstruation until the fourth day thereafter. In addition, two minor increases were found on the first post-menstruation day and around ovulation. These patterns were similar for oral contraceptive users and non-users. Unterberg (1998) compared crying frequency and crying proneness in adolescents and found that menstruating girls (in the age range 12 -15) reported a higher crying

proneness than did non-menstruating girls of the same age. No differences were found in crying frequency, however.

The retrospective character of these studies prevents drawing any definitive conclusions. Therefore, quasi-experimental studies should be designed in order to obtain more interpretable data. Further concurrent research is needed in order to obtain better insight into the nature of these differences. Do they result from different methodologies or do other factors play a substantial role as well? In contrast to the expectation of Frey and his coworkers, crying peaks did not correlate with levels of any single sex hormone such as progesterone or estrogen. Crying during pregnancy and during the post-partum period ("maternity blues") also need more systematic research, with adequate attention to hormonal fluctuations (in particular prolactin).

A final word. It may not always be conceptually clear whether or not psychological state variables should be considered triggers of crying or variables that moderate crying. One could argue that the mood of a person before exposure to an emotional stimulus is relevant for the subsequent reaction. In that case, it appears more appropriate to consider psychological state as a moderator. However, we are not aware of any study in which crying has been examined as a function of preexisting transient mood.

The effects of crying

On others. As suggested by the model presented in Figure 1, crying may have a variety of both direct and indirect effects on the social environment (i.e., others who are present) and the person who cries. The results of the studies by Jesser (1982) and Labott et al. (1991) described earlier, as well as a recent study by Hill and Martin (1997) suggest that crying may be a powerful elicitor of sympathy and, occasionally, empathic crying. Because of this, Cornelius, along with a number of researchers (e.g.,

Cornelius, 1997; Fridlund, 1994; Frijda, 1986, 1997; Kottler, 1996), has argued that crying may communicate a variety of personal needs and desires and that crying may be used instrumentally by people to communicate their needs and desires and alter situations to their liking. Cornelius (1981) asked participants to give detailed reports of those situations in which they had cried in the presence of other persons. His results strongly suggested that crying was instrumental in terms of changing the situation for the better. Shedding tears often elicited comforting behavior, especially when the crying person was a woman. The effects of crying on the situation are important in that there is evidence suggesting that such effects can influence the affective experience of the person who cries (Cornelius, 1997).

On mood. Cornelius (1997) reviewed the available literature on crying and its effect on mood and identified six studies providing evidence that people generally feel better after a crying episode. However, it is important to note that all of these studies were retrospective. Moods were not assessed in the actual emotion-eliciting situation or immediately after the crying episode but at a later time. In contrast, the results of studies measuring mood immediately after a crying episode all yielded negative effects. Thus, there appears to be a discrepancy in research findings which may be related to the employed methodology. In retrospect, people often report that they felt better after having cried, although it is unlikely that they actually felt relief immediately afterward.

Studies finding that crying leads to emotional relief and studies finding that crying does not lead to emotional relief further differ with respect to the context of the crying. Positive effects have been found only in real life studies, whereas negative effects have been obtained primarily in more artificial, laboratory studies, in which participants, for instance, were exposed to sad movies. Cornelius (1997) argued that participants in laboratory studies may not feel better after a crying episode because in such situations crying does not have any effect on the situation.

His speculation that participants would report feeling better after crying only if the events or situation that elicited the crying response has been resolved or if the tears have any other positive effect, received partial empirical support. However, alternative explanations should also be considered.

Zeiss and Ranieri (1981) investigated why people (in particular women, see Bekker and Vingerhoets, 1999) sometimes willingly engage in activities that make them feel sad, such as watching sad movies. The explanation given for this phenomenon was that individuals who apply this negative mood induction give more positive evaluations of events occurring immediately after this self-induced mood than they were inclined to do before. One may wonder whether the same phenomenon may also play a role in crying and the feelings of relief and improved mood afterwards. As an explanation for this phenomenon, reference is made to the opponent-process theory of acquired motivation of Solomon (1980), which attempts to account for a wide variety of acquired motives, including drug addiction, love and affection, and phenomena which may have aversive components, but still may be appreciated, such as sauna bathing, parachuting, and marathoning. A final and rather trivial explanation may be that the reported mood improvement actually is an "artifact," a necessary and logical consequence of the fact that one only cries when emotions are indeed very strong and deep. This would imply a basement effect with the result that any later mood assessment necessarily will demonstrate a change for the better.

Crying and Health

In the popular media, there is little disagreement regarding the view that crying is healthy (cf. Cornelius, 1986; Vingerhoets & Scheirs, 1998). However, it is not always clear what is precisely meant by this. Theoretically, there are two global ways to explore the relationship between crying and health. First, one may focus on the

immediate psychological and psychobiological effects of crying and/or actively inhibiting tears. Second, studies may address the relationship between crying frequency and/or crying proneness and health status.

Since the effects of crying on mood have already been discussed above, we will here limit ourselves to studies in which psychobiological variables were measured. To this end, we will briefly summarize the findings of studies in which cardiovascular, hormonal, and immune measures have been collected.

Studies in which heart rate data were obtained (Gross, Fredrickson, & Levenson, 1994; Kraemer & Hastrup, 1988; Marston, Hart, Hileman, & Faunce, 1984) revealed either no differences between cryers and non-cryers or increased arousal in crying individuals. Gross et al. (1994) concluded that their results failed to support the view that crying may facilitate physiological recovery and promote homeostasis. In the study of Vingerhoets and Kirschbaum (1997), in which cortisol was measured, there was also no evidence of any effect of crying on the activity of the hypothalamus-pituitary-adrenal axis. Finally, two studies (Labott, Ahleman, Wolever, & Martin, 1990; Martin, Guthrie, & Pitts, 1993) assaying immunological variables both showed a negative effect of crying on secretory immunoglobulin A, an immunologic variable that is characterized as a first-line defense against invasion by potential pathogens.

On the other hand, there is some anecdotal evidence that crying has a reciprocal relationship to urticaria, a chronic skin irritation. Saul and Bernstein (1941) report on a patient who did not have urticaria when she cried and whose attacks usually terminated with crying. On the other hand, the suppression of crying was associated with the onset of the symptoms. In contrast, Borgquist (1906) presented some unsystematic observations of people who suffered from a variety of symptoms like headache and nausea after a crying episode.

Recent work by Gross (1998) suggests that the active inhibition of any emotional response may be accompanied by increased sympathetic arousal. In addition to the direct effects of crying, one should be aware of the possibility that psychobiological effects also may be brought about indirectly by the (positive) reactions and emotional support from the social environment.

A topic that we do not want to leave undiscussed here is the work of Panksepp and coworkers on distress vocalizations in animals (see Panksepp, 1998 for an overview). Based on their work, it may be hypothesized that crying may trigger the release of certain endogenous opioids, which may have a sedative and pain reducing effect. Panksepp also suggests as a main function of these substances the facilitation of recovery after having been in distress. These hypothesized effects thus match nicely the supposed functional effects of crying (sedation, pain reduction, restoring the homeostatic balance).

In short, the hypothesized underlying psychobiological mechanisms responsible for the assumed relief from an overcharged nervous system (cf. Borgquist, 1906) or the removal of toxic waste products released by crying (Frey, 1985) have not received empirical support in studies of the immediate health consequences of crying.

A second source of data on crying and health are studies on the relationship between crying frequency and/or proneness and health status. Do people who cry relatively often generally feel better and are they in better health than those who cry seldom or never? Or, the other way around, do patients, in particular, those with psychosomatic disturbances, cry less frequently than healthy controls? The few studies addressing these questions have failed to yield a consistent pattern. Vingerhoets et al. (1993) reported a correlation of exactly .00 between self-reported health and crying frequency in a group of 131 women. Bronstein et al. (1996), in their study among adolescents, reported a positive association between crying proneness and adjustment (including well-being) for boys, whereas for the girls a negative

association was found. These investigators suggest that crying may be beneficial only to a certain extent. Crepeau (1981) investigated self-reported crying behavior in ulcer patients, colitis patients, and healthy controls. Her results indicated that, compared with healthy controls, the patient sample cried less frequently and evaluated crying more negatively. These results thus seem to corroborate some psychosomatically oriented hypotheses (e.g. Groen, 1957; Sadoff, 1966). However, the patient groups were not clearly defined and there were other methodological problems with the study. Moreover, Schlosser (1986) failed to find an association between crying frequency and physical disorder.

Labott and Martin (1990) examined the relationship between emotional coping (both humor-coping and cry-coping) and physical health. In contrast to Crepeau's (1981) results, they found that both in women and in low-income participants, a positive relation was found between physical disorder and crying. Vingerhoets et al. (1992) failed to find any differences in crying frequency between hyperprolactineamic patients and healthy controls.

Of further interest is a case-study by Linton (1985), who reported on the treatment of a 26-years old woman seeking help because of her inability to express emotions, in particular, sadness and crying. Since childhood, she had refrained from crying. Applying a comprehensive behavioral treatment including assertion training oriented towards emotional expression plus modeling and systematic shaping of crying behavior, this patient learned to express her feelings and to cry. This treatment had a positive effect on her sleep problems and anxiety, resulting in a significant increase in feelings of well-being. Of course, case studies like this one have limited scientific value and no definitive statements about cause and consequence relations are allowed. Nevertheless, for the sake of completeness we do not want this study left unmentioned. However, when evaluating these data, one should be aware that even in the case of obtaining support for the hypothesis that

patients cry less frequently, it does not necessarily follow that low crying frequency is causally related to the development of disease. In the case of asthma, for example, patients may have learned to avoid crying because it may lead to an exacerbation of pathophysiologic symptoms, like wheezing (cf. Miller, 1987; Miller & Wood, 1997). On the other hand, especially in cases of mental or neurological disorder, changes in crying frequency or proneness may be a symptom of a mental disturbance (cf. Davis, Lambert, & Ajans, 1969; Hamilton, 1982; Hastrup, Baker, Kraemer, & Bornstein, 1986; Mangweth, Ebner, Kemmler, Kinzl, Biebl, & Vingerhoets, 1999; Okada, 1991). In addition, neurological diseases such as stroke, multiple sclerosis, and Parkinson's disease, may be accompanied by "emotional incontinence" or "pathological crying and laughing." Characteristic is the uninhibited emotional reaction to neutral stimuli (e.g., Andersen, Vestergaard, & Ingeman-Nielsen, 1995; Robinson, Parikh, Lipsey, Starkstein, & Price, 1993; Shaibani, Sabbagh, & Doody, 1994). In addition to being a symptom of the disease itself, crying frequency may also be changed significantly as an expression of distress in response to the diagnosis of a serious chronic or life threatening disease or it may be a side effect of medication (e.g., Oleshansky & Labbate, 1996). Taken together, we recommend when investigating the relationship between crying and health, both linear and curvilinear (inverted U) associations should be seriously considered.

One study (Labott & Martin, 1987) specifically focused on the hypothesis that crying may act as a moderator variable, revealing its positive effects in adverse and stressful situations (cf. Lipe, 1980). However, the results of this study did not lend support to the hypothesis that crying facilitates the coping process resulting in a better mood after exposure to a stressor.

A final point that should be considered is that the relationship between crying and health may be a spurious one. For example, there is clear evidence summarized above that crying is related to personality and coping. These factors may in turn also

be related to health status, implying that coping and personality should be regarded as third variables. Figure 2 schematically summarizes the different postulated relationships between crying and health.

insert figure 2 about here

To summarize, until now, scientific studies have yielded little evidence in support of the hypothesis that shedding tears is healthy. In contrast, there is some evidence suggesting that crying may be rather bad for one's health status. This is not to say that crying is a useless behavior. It has strong effects on the environment, promoting comforting and helping behavior, possibly indirectly resulting in positive mood and health effects.

Conclusion

What we do and do not know about crying

There is obviously still much to be learned about crying, but a more or less clear picture is emerging of the physiological mechanisms underpinning crying, the kinds of situations in which it occurs, the emotions (both antecedent and consequent) with which it is associated, and the sociodemographic factors (e.g., gender) that appear to moderate it. We know much less, however, about such things as the specific patterns of appraisal that are involved in the elicitation of crying. Crying in adults is associated with feelings of helplessness and powerlessness, but it is unclear at present if these feelings are components of the appraisals that bring about crying or are simply feelings that accompany crying. The picture of the effects that crying has on a person's mood and self-evaluation is also less than clear.

Participants consistently report feeling better after crying but laboratory demonstrations of such effects are difficult to come by. Analogously, the relationship between crying and positive health outcomes is far from unambiguous.

While crying appears to have very powerful effects on others, it is not entirely clear how crying is influenced by the situation and, in particular, by the reactions of others to a person's crying. It is very clear, however, that reactions to crying depend on the gender of both the person crying and the person witnessing the crying. There is some evidence, at least from the United States, that the influence of gender on crying may be changing. Progress in understanding the effects of social context on crying may be hindered by a lack of consensus on whether or not to conceive of crying as a communicative display (cf. Cornelius, 1997; Fridlund, 1994).

Thinking of the social context of crying more broadly, there is still much to be learned about cultural influences on crying. Data collected by the International Study on Adult Crying (ISAC; Vingerhoets & Becht, 1997) support the notion that crying is a universal form of emotional expression but also indicate that there are important differences among cultures in the frequency of crying. The sources of such differences, however, remain unexamined at present.

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Figure Captions

Figure 1. A model of adult crying (see text for explanation).

Figure 2. Direct and indirect influences of crying on well-being and health status.

