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Antecedents, Boundary Conditions, and Consequences of Emotional Crying: The ABC of Crying

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Abstract

Humans are probably the only creatures that can shed emotional tears. This observable phenomenon represents the core feature of emotional crying, which is investigated in this dissertation. The thesis analyzes situational antecedents, person-related boundary conditions and intra-/ inter-individual consequences (i.e., the ABC) of emotional crying.

Chapter 1 expands upon the literature's established definition of emotional crying by incorporating considerations from emotion and motivation theories. In Chapter 2, the functionality of emotional crying is discussed, addressing prominent ideas such as the catharsis hypothesis and the social signal hypothesis; furthermore, considerations of how the phenomenon of emotional crying may have evolved are presented. In Chapter 3, the influence of person-related variables on the shedding of emotional tears is highlighted. The concepts of personality traits, attachment style, and depression are considered in this context. Chapter 4 addresses how situational antecedents are linked to emotional crying. Building on the considerations from Chapter 1, a taxonomy is presented that can be used to categorize episodes in which emotional tears are shed. Chapter 5 discusses research methods used to study the phenomenon of emotional crying. Ambulatory Assessment is framed as a complementary research method that allows for the investigation of emotional crying in participants' everyday life, and this method is compared to already established approaches. The Telegram-Survey-Bot is presented as a free and open-source software to conduct such studies. In addition, the methodology of my empirical work is reflected considering the replication crisis and the Open Science movement. In total, five studies with $N = 1746$ participants are presented and various theoretical considerations are outlined to shed light on the phenomenon of emotional crying.

In the concluding discussion, the phenomenon of emotional crying is embedded in a broader context by applying an emotion regulation perspective. Finally, limitations of the present work are discussed and avenues for future research projects are presented to advance

the understanding of the highly interesting phenomenon of human emotional crying. In summary, this dissertation on “the ABC” of crying contributes to a much better understanding of the phenomenon of shedding emotional tears and human functioning in general.

Zusammenfassung

Menschen sind wahrscheinlich die einzigen Lebewesen, die emotionale Tränen vergießen können. Dieses beobachtbare Phänomen stellt das Kernmerkmal emotionalen Weinens dar, welches in der vorliegenden Dissertation untersucht wird. Die Arbeit analysiert situative Antezedenzien (engl. *situational antecedents),* Persönlichkeitseigenschaften (engl. *person-related boundary conditions*) und intra-/ inter-individuelle Konsequenzen (engl. *intra-/ inter-individual consequences)* des emotionalen Weinens (*the ABC of crying*).

In Kapitel 1 wird die in der Literatur etablierte Definition von emotionalem Weinen erweitert, indem Überlegungen aus Emotions- und Motivationstheorien Berücksichtigung finden. In Kapitel 2 wird die Funktionalität von emotionalem Weinen diskutiert, wobei auf prominente Ideen, wie die Katharsis Hypothese und die Social Signal Hypothese eingegangen wird. Weiterhin werden Überlegungen dargestellt, wie das Phänomen emotionales Weinen entstanden sein könnte. In Kapitel 3 wird der Einfluss personenbezogener Variablen auf das Vergießen emotionaler Tränen beleuchtet. Dabei finden die Konzepte Persönlichkeitsmerkmale, Bindungsstil und Depression Berücksichtigung. Kapitel 4 beschäftigt sich mit der Frage, wie situativen Merkmale mit emotionalem Weinen verknüpft sind. Aufbauend auf den Überlegungen aus Kapitel 1 wird eine Taxonomie präsentiert, anhand derer Episoden kategorisiert werden können, in denen emotionale Tränen vergossen werden. In Kapitel 5 werden Forschungsmethoden diskutiert, die genutzt werden, um das Phänomen emotionales Weinen zu untersuchen. Ambulatory Assessment wird dabei als eine komplementäre Forschungsmethode vorstellt, die es erlaubt, emotionales Weinen im Alltag von Proband*Innen zu untersuchen und diese Methode wird mit bereits etablierten Vorgehensweisen verglichen. Der Telegram-Survey-Bot wird als eine freie und kostenlose Software-Option vorgestellt, um solche alltagsnahen Studien durchzuführen. Zudem wird die Methodik meiner empirischen Arbeiten vor dem Hintergrund der Replikationskrise und der

Open Science Bewegung reflektiert. Insgesamt werden fünf Studien mit N = 1746 Proband*innen vorgestellt und verschiedene theoretische Überlegungen dargelegt, um das Phänomen emotionales Weinen zu beleuchten.

In der abschließenden Diskussion wird das Phänomen emotionales Weinen mit Hilfe einer emotionsregulatorischen Perspektive in einen breiteren Kontext eingebettet. Vor diesem Hintergrund werden die Limitationen der vorliegenden Arbeit diskutiert und Denkanstöße für zukünftige Forschungsprojekte präsentiert, um das Verständnis über menschliches emotionales Weinen weiter voranzutreiben. Insgesamt trägt diese Dissertation über „das ABC“ des Weinens zu einem besseren Verständnis des Phänomens des Vergießens von emotionalen Tränen und des menschlichen Erlebens und Verhaltens im Allgemeinen bei.

1. INTRODUCTION

„I like to see people reunited, maybe that's a silly thing, but what can I say, I like to see people run to each other, I like the kissing and the crying, I like the impatience, the stories that the mouth can't tell fast enough, the ears that aren't big enough, the eyes that can't take in all of the change, I like the hugging, the bringing together, the end of missing someone [...]" from the novel *Extremely Loud and Incredibly Close* by Jonathan Safran Foer (p. 109).

This quote gives an idea of how complex and fascinating the phenomenon of emotional crying is: First, humans cry in emotionally charged situations. Per the above quoted passage, these situations can be associated with positive emotions, but people also shed tears when they are sad. Second, crying is often embedded in a social context; hence, crying regulates social interactions as it affects how crying individuals are perceived and how observers respond to somebody who is crying. Third, the catharsis-thesis suggests that humans feel relieved after crying, so in addition to *inter*personal features, crying is assumed to comprise *intra*personal features. Fourth, there seems to be interindividual variance in how often people cry and for what reason. While some individuals always shed tears at reunions, some do it from time to time, while others never do it. Crying thus requires a comprehensive analysis, which is what this dissertation aims to do. Specifically, situational antecedents, person-related boundary conditions, and consequences (i.e., the ABC) of emotional crying are examined.

Studying emotional crying seems particularly worthwhile for the following reasons. Besides humans, most likely no other species can shed emotional tears (Vingerhoets et al., 2000). While distress vocalizations are part of the behavioral repertoire of most mammals and some bird species, emotional crying seems to be uniquely human (Vingerhoets, 2013). The analysis of crying thus holds the potential to reveal basal knowledge about human functioning. Human crying has been observed on all continents (van Hemert et al., 2011) and in individuals of all ages (Rottenberg & Vingerhoets, 2012). Even though crying is subject to culture-specific

influences (e.g., norms regarding expression of emotions, van Hemert et al., 2011) and varies across the life span (infants often cry because of physical pain, adults rarely do; Gračanin et al., 2018), it seems fair to state that crying is not a marginal but a general phenomenon. Moreover, crying is assumed to emerge in circumstances that the crying individual appraises as relevant. So, examining crying means illuminating situations that matter to people (Moors et al., 2013).

Interestingly, we can directly observe whether a person cries or not. Since crying comprises this *behavioral* expressive component, observers can perceive it visually and auditorily (i.e., seeing tears and hearing sobbing). Due to this property, crying is a highly attractive research topic, since its analysis is not restricted to *introspective* self-reports. Over the past years, psychological research has shifted from the study of behavior to the study of introspective self-reports, a trend that has been repeatedly problematized (Baumeister et al., 2007; Fiedler, 2014). Nothing is wrong with the study of introspective self-reports, per se; attitudes and intentions, for example, are highly relevant research topics (e.g., Sheeran et al., 2016). However, an exclusive focus on this approach is problematic since psychology aims to understand and to explain human experience and *behavior*. In this sense, crying is a particularly suitable research object, as it can be analyzed on both a behavioral and an experiential level.

1.1. Overview of the present work

This dissertation is devoted to adult rather than infant crying (for a review on infant crying, see Zeifman, 2001). Specifically, this dissertation deals with the following four research questions: Chapter 2 addresses the question: What is the function of shedding emotional tears? Afterwards the most prominent hypotheses dealing with the question of what is crying good for are outlined, including the catharsis thesis and the idea that tears are an important social signal. Evolutionary considerations of how the shedding of emotional tears may have evolved are discussed. Chapter 3 focuses on how factors that lie in a person are related to the shedding of emotional tears. In this discussion, the concepts of personality traits, attachment styles, and

depression are considered. Bushman and Anderson (2002) as well as Kanfer and Saslow (1969) suggest that human behavior is determined by personal and situational factors. Chapter 4 is therefore devoted to the question which situational factors are related to the shedding of emotional tears. Specifically, the hypothesis is examined that episodes involving emotional tears can be differentiated by how they affect psychological needs (e.g., the need for relatedness; Deci & Ryan, 2000). In Chapter 5, the research designs and practices are evaluated that are typically used when emotional crying is examined and a complementary assessment strategy is presented, which involves the smartphone-based collection of data in participants' everyday life. Here my empirical work is discussed against the background of the replication crisis and the application of open science practices.

In sum, the present dissertation deals with the situational antecedents, person-related boundary conditions, and consequences (i.e., the ABC) of emotional crying. Before discussing the above-mentioned research questions in detail, the phenomenon of emotional crying is defined and embedded in a nomological net, drawing on considerations of emotion and motivation theories.

1.2. Definition of emotional crying

Human emotional crying can be defined as the production of tears in response to an emotional trigger and could additionally involve vocalizations, sobbing, certain facial expressions, and body movements (Bylsma et al., 2021; Vingerhoets et al., 2000). In other words, the shedding of tears *uncaused* by a physical irritation of the eye is the dominant feature of emotional crying. Furthermore, tears can only emerge when emotion regulation strategies are not applied to suppress them (Gross et al., 2011). The anatomical and neuronal basis of tear production are discussed in the next paragraphs.

1.3. Anatomical and neuronal basis of shedding tears

Besides emotional tears, humans also produce basal and reflex tears (Murube, 2009). The basal tear film keeps the eye lubricated and supplies the outer cells of the cornea with nutrients. In addition, the smooth film improves the refractive properties of the ocular surface (Schünke et al., 2009). Tears are a complex transparent liquid mainly consisting of water, proteins, and electrolytes (Bylsma et al., 2019). Three layers can be distinguished: a lipid layer, an aqueous layer, and a mucous layer. The lipid layer prevents the tear film from evaporating too quickly; it is produced by the Meibomian glands which are located at the edge of the upper and lower eyelids. The middle layer is secreted by the lacrimal glands, and it accounts for the largest volume in the tear film. Accordingly, reflex and emotional tears mostly consist of it. The mucous layer has a jellylike consistency that stabilizes the tear film. It is secreted by the lacrimal glands and the goblet cells (located in the conjunctiva). This tear film is distributed by the eyelid 20 to 30 times per minute (Schünke et al., 2009). The lacrimal gland lies in the upper lateral region of the orbit, specifically in the lacrimal fossa (see Figure 1). The tear fluid is absorbed via the lacrimal puncta, from where the tears are drained into the lacrimal canaliculi, the lacrimal sac, and via the nasolacrimal duct into the nose (Schünke et al., 2009). When more tear fluid is produced than can be absorbed through this system, tears are shed.

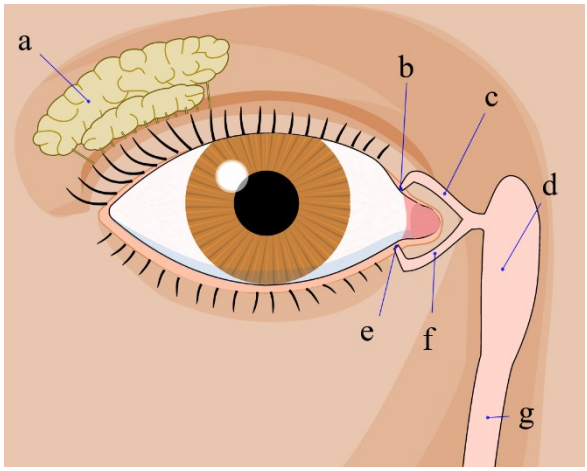

Figure 1. Structure of the tear system. a: tear gland/lacrimal gland; b: superior lacrimal punctum; c: superior lacrimal canal; d: tear sac/lacrimal sac, e: inferior lacrimal punctum; f: inferior lacrimal canal; g: nasolacrimal canal. From Silversmith (2006).

The lacrimal glands are innervated by the autonomic nervous system (ANS; Bylsma et al., 2019). The role of the parasympathetic nervous system (PNS) seems to dominate, since its stimulation more directly modulates tear secretion than stimulation of the sympathetic nervous system (SNS; Dartt, 2009). The sensory afferent nerves from the cornea and conjunctiva enable a reflex lacrimation in response to environmental changes, for example, when a foreign object enters the eye. Even though referred to as the "trigeminal-parasympathetic reflex", it is not a simple reflex since the sensory input is modulated in the so-called lacrimal nuclei, located in the superior salivatory nucleus (pontine tegmentum; Bylsma et al., 2019). The lacrimal nuclei receive input from various areas, such as the prefrontal cortex and the periaqueductal gray and limbic structures like the anterior cingulate cortex (for a detailed description, see Dartt, 2009). Since most knowledge concerning the neuronal circuitry underlying human emotional crying comes from single case studies and animal studies, it must be treated with caution. One near-infrared spectroscopy (NIRS) study identified the involvement of the medial prefrontal cortex (mPFC) in emotional crying in humans (Sato-Suzuki et al., 2007). However, the sample comprised only eight participants, and since the mPFC has been related to emotion processing and regulation in general (e.g., Etkin et al., 2011), it is questionable whether this result could be considered as crying specific.

Compared to case and animal studies, quasi-experimental studies assessing skin conductance, heart rate, and heart rate variability in human participants revealed somewhat contradictory results. A confrontation with sad movie clips was typically associated with SNS activation at the onset of crying, while PNS activation dominated at the end of the crying episode (for a review, see Bylsma et al., 2019). The contradictory findings can be explained in different ways. First, it is difficult to precisely define the onset and offset of a crying episode, which in turn makes difficult an exact temporal assignment of the physiological correlates. Second, the findings could be confounded through associated behavioral components such as sobbing,

vocalizations, or body movements (Bylsma et al., 2019). Third, since humans and animals differ in their ability to shed emotional tears, it seems plausible to assume that humans and animals also differ in their neuronal correlates of tear production.

In summary, the lacrimal glands produce the main amount of tear fluid. They are innervated by the ANS, but it is unclear whether a parasympathetic or a sympathetic influence dominates. The definition of emotional crying will now be refined by drawing on an appraisal-theoretical perspective of emotions. When the terms *crying* and *tears* are used in the following, they refer to emotional crying and emotional tears.

1.4. Approaching emotional crying from an appraisal theory perspective

As the very terms *emotional crying* and *emotional tears* suggest, emotions are a crucial concept in the context of crying. Thus, to understand emotional crying, it seems appropriate (if not necessary) to consider basic assumptions about emotions. Specifically, emotional crying is discussed from an appraisal-theoretical perspective. Considering the conceptual overlap between different emotion theories (Gross, 2015), these considerations are not restricted to appraisal-approaches, but also apply to basic emotion approaches (e.g., Ekman, 1972) and social construction approaches (e.g., Harré, 1986). All these theories comprise the following assumptions: Emotions involve different components that influence each other (i.e., physiology, behavior, subjective experience). Emotions develop over time and last for seconds to minutes, while mood is considered to last much longer (Gross, 2015). Emotions can be triggered by internal or external stimuli, and they may differ in how helpful they are. That is, individuals might be misguided by emotional states (for a review, see Lerner et al., 2015) or they might be prepared for an adequate response (e.g., Seo & Barrett, 2007).

„Emotions are not random events—they occur when something happens to us" (Scherer & Moors, 2019, p. 721). This quote illustrates one core assumption of appraisal theories. Emotions arise when something relevant, such as needs, plans, or values is affected. Following

a conceptualization by Shariff and Tracy (2011), two main functions of emotions can be distinguished (see also Frijda & Scherer, 2009). First, they prepare the organism for proper response. Second, they communicate information to others (Hareli & Hess, 2012). Current appraisal approaches conceptualize emotions as dynamic processes rather than fixed states (Scherer & Moors, 2019). An emotion episode is assumed to comprise the following components: a) appraisal of the situation; b) action preparation; c) physiological response; d) expressive behavior; and e) subjective feeling. Shedding emotional tears can be assigned to component (d).

Scherer and Moors (2019) propose that these components are related in an interactive manner. For example, increasing arousal contributes to the subjective feeling of fear. In turn, the subjective feeling of fear has the potential to further increase arousal. Even though emotion episodes are assumed to be characterized by interaction and synchronization of all features, the appraisal component plays a special role, since it represents the decisive factor in determining the direction of the emotion episode. If an event is appraised as both positive and unexpected, this might lead to a mix of subjective happiness and surprise. However, if the positive event is expected, this would probably lead to happiness but without surprise. It is therefore worth taking a closer look at the appraisal process. Appraising means evaluating a stimulus of the environment regarding its impact on one's well-being (Moors et al., 2013). Stimuli can be either appraised to satisfy or to frustrate well-being (Frijda, 1986), and this evaluation can take place against different backgrounds. If short-term goals serve as a frame of reference, appraisals can strongly vary inter-individually, since current goals can be idiosyncratically very different. If, on the other hand, psychological needs, like the need for relatedness (Deci & Ryan, 2000), serve as a frame of reference, the appraisals of different individuals are more similar, since it is assumed that psychological needs apply to all people (and thus vary less strongly than short-

term goals). A focus on psychological needs seems therefore worthwhile to better grasp the phenomenon of emotional crying.

1.5. The role of psychological needs in crying

Human existence is coupled to certain tangible preconditions, e.g., sufficient water, air, sleep, etc. In addition to these prerequisites, more abstract psychological needs, like belongingness (Baumeister & Leary, 1995) seem to be important for human well-being. Maslow (1954) was one of the first to propose the following analogy for psychological needs: Psychological needs are like vitamins; if they are consumed regularly and sufficiently, the organism is fine. If there is an undersupply of vitamins, this is harmful for the organism. Prentice and colleagues (2014, p.82) define psychological needs as "tendencies to seek out certain basic types of psychosocial experiences, to a somewhat varying extent across individuals, and to feel good and thrive when those basic experiences are obtained, to the same extent across individuals".

While tangible preconditions (e.g., water), can be easily identified as essential, the case is less clear for psychological needs due to their latent nature. Accordingly, a multitude of theories have been put forward, suggesting partially overlapping but also diverging psychological needs. Some of these suggestions are now given as an example: belongingness (Baumeister & Leary, 1995), attachment, control/orientation, increasing pleasure/avoiding pain and self-enhancement (Grawe, 2004), safety/nurturance, autonomy/competence/sense of identity, freedom to express needs/opinions/emotions, spontaneity/play, and realistic limits/ self-control (Young et al., 2003), relatedness, autonomy and competence (Deci & Ryan, 2000). The self-determination-theory (SDT, Deci & Ryan, 2000) is probably the most intensively studied framework of psychological needs available to date. It assumes that humans have the urge to experience social connectedness (relatedness), mastery (competence), and autonomy (experience one's own behavior as self-reliant). Supporting evidence was found, since

satisfaction/frustration of these needs independently explained variance in well-being (Sheldon et al, 2001, 2011), a pattern that could be observed in over 120 countries around the world (Tay & Diener, 2011). This suggests that relatedness, autonomy, and competence apply to humans *universally* and that a frustration of these needs is generally associated with ill-being and performance decrements, whereas satisfaction is generally related to well-being and capacity.

1.6. Refining the definition of emotional crying

Conceptualizing the shedding of tears from an emotion-theoretical and a psychological need perspective suggests the following amendments to the above-mentioned definition of emotional crying. The shedding of tears can be understood as an expressive behavior within an emotion episode. Crying occurs in situations that have some inherent relevance, otherwise no (strong) emotional response would be elicited. Psychological needs can be used as a framework to understand which situations are particularly potent in triggering emotional tears. The self-determination theory proposes that relatedness, autonomy, and competence are universal psychological needs for which individuals are striving to reach satisfaction. A satisfaction of these needs is associated with positive affective responses, while their frustration is related to negative affective responses. Since tears can be associated with both positive and negative emotions (Vingerhoets et al., 2001), it is postulated that crying episodes involve an appraisal process in which basic psychological needs are to some extent satisfied or frustrated.

In summary, Chapter 1 described the anatomical, and neuronal basis of tear production. It also involved an amended definition of emotional crying by considering that crying is an expressive behavior that is probably associated with a satisfaction/frustration of psychological needs. This idea is discussed in Chapter 4, but before the functions emotional crying potentially has are discussed. Following Shariff and Tracy's (2011) assumptions on the intrapersonal and interpersonal effects of emotions in general, the consequences of shedding tears for crying individuals and for observers are reflected.

2. ON THE FUNCTIONS OF SEHDDING TEARS

Whether or not a person is crying can be observed from the outside. Accordingly, crying can be classified as an *expressive behavior* (see Bylsma et al., 2021, for a similar conceptualization), and as with any behavior, hypotheses can be made regarding its purpose. Several ideas have been put forward regarding the functionality of crying, and the most prominent ones are reviewed in this chapter. This discussion is closed with considerations about how emotional crying might have evolved.

2.1. Biological homeostasis hypothesis

Frey (1985) proposed that tears function as sewage for toxic substances accumulated in the blood during stress periods. As kidneys purify the blood and excrete toxic substances through the urine, so do the lacrimal glands through the flow of tears, according to Frey. While this consideration might be consistent with the subjectively perceived relief after crying, several reasons argue against this biological homeostasis hypothesis. First, there are only negligible compositional differences between stress-related tears and reflex tears (i.e., due to physical irritation of the eye; Frey et al., 1999). Second, very little blood passes through the lacrimal glands. Given that kidneys filter about 1.2 liters of blood per minute, it is highly unlikely that lacrimal glands serve a biological cleaning function (Murube et al., 1999). Hence, Frey's (1985) hypothesis on the function of tears can be regarded as false.

2.2. Catharsis thesis

The *catharsis hypothesis* is probably the most prominent candidate concerning the intrapersonal functionality of crying. Rooted in psychodynamic tradition (e.g., Breuer & Freud, 1895), it is assumed that tears reflect a safety valve that allows one to relieve distress and to reduce arousal (Rottenberg et al., 2008a). Even though this assumption is widespread among laypersons (e.g., Cornelius, 1986), the empirical evidence is anything but clear. The majority of survey respondents, for example report affective improvement after crying (Becht &

Vingerhoets, 2002; Bylsma, Vingerhoets & Rottenberg, 2008; Rottenberg et al., 2008b). When crying is assessed on a daily basis, the association is less consistent. Frey and colleagues (1983) found a decrease in negative affect after crying for most crying episodes, while Bylsma et al. (2011) observed this pattern only for every third crying episode. When studied in the lab, several studies failed to detect affective improvement for participants who were presented with a sad video clip (Rottenberg et al., 2002; Gross et al., 1994). The literature provides two considerations to resolve these heterogeneous findings. First, Gračanin et al. (2015) argued that lab studies in which no affect improvement was observed, affect was measured directly after crying. It seems plausible to assume that distress and arousal have not decreased immediately after crying, as this process seems to take time (see also Cornelius, 2001; Gross et al., 1994; Rottenberg et al., 2008a). In their quasi-experimental study, Gračanin et al (2015) observed worsened affect directly after crying, but 90 minutes after crying, participants reported more positive affect compared to baseline. Thus, considering the course of time seems to be of importance when analyzing the effects of crying in the lab. Second, crying in the lab differs from crying in naturalistic settings, and catharsis might only emerge under certain circumstances (Rottenberg et al., 2008a). This assumption aligns with former theorizing, suggesting that catharsis might be dependent on the presence of empathic and helping others (Borgquist, 1906) and is empirically supported by the finding that individuals report mood benefits when they received social support (vs. not) when crying was assessed on a daily basis (Bylsma et al., 2011).

Two additional considerations might be relevant in this context. First, research focusing on the cathartic aspect of tears often considers crying a *necessary* condition for the reduction of distress and arousal. Hesdorffer et al. (2018, p.414), for example, hypothesized “that non-criers would have lower well-being [...]”. This assumption seems daring, since it implies that crying is the only option that can reduce distress and arousal. Many empirical findings contradict this assumption. Arousal can also be reduced by cognitive (e.g., Parsons et al., 2021) and

mindfulness-based interventions (e.g., Ong & Moore, 2020), to name just two alternatives. Accordingly, crying is more likely a *sufficient* condition to reduce distress and arousal. If one applies this perspective, one would have to extend the hypothesis of Hesdorffer and colleagues: Non-criers should have a lower well-being only if they have no other possibilities of reducing distress and arousal. Second (and related to the first thought), non-crying can be associated with perfect well-being, when there is nothing to cry about. When analyzing cathartic crying, researchers should consider whether individuals faced a trigger that could have made them cry. But what are the typical reasons that make people cry? Although several researchers have tried to answer this, no definite conclusion yet exists. This discussion will be revisited in Chapter 4.

2.3. Crying as social signal

As already mentioned, crying also seems to involve interpersonal functions. For example, the visibility of tears leads observers to believe that the crying person is sad and helpless (Balsters et al., 2013; Hendriks & Vingerhoets 2006; Provine et al., 2009; Zeifman & Brown 2011). Most research examining the interpersonal function of crying was conducted in the context of the *social support hypothesis* which assumes that emotional crying is a universal social signal that increases social bonding and support intentions in others (Hendriks et al., 2008; Kottler, 1996; Murube et al., 1999; Nelson, 1998; Zickfeld et al., 2021). Vingerhoets et al. (2016) postulated that the visibility of tears increases the perceived helplessness of the crying individual which in turn should increase the intention to help her/him. A second explanation for increased helping intention in reaction to tears involves the reduced aggression potential signaled through tears (Hasson 2009; Hendriks et al. 2008). Put differently, tears might signal that the crying individual is agreeable, friendly and warm which should lead to more helping intentions from observers (Vingerhoets et al., 2016). Third, tears might increase helping intentions by strengthening the social bond between crying and observing individual since helping is more likely the closer we feel to another person (e.g., Korchmaros & Kenny, 2001).

Vingerhoets and colleagues (2016) found evidence in favor of two of these explanations by showing participants pictures of faces from which tears were digitally removed (or not). The visibility of tears caused increased helping intentions mediated through perceived helplessness and connectedness in two studies, while the latter relation was weaker than the former. A weak mediation effect could be observed for friendliness in one of the studies. Stadel et al. (2019) replicated most of these findings by analyzing whether the gender-composition of crying and observing individual functioned as moderator. While helplessness functioned as a mediator for female and male observers, tears increased willingness to help via connectedness only in female observers. In line with the unstable relation in the original study, friendliness was not a significant mediator. The most comprehensive analysis of interpersonal effects of crying is a recent registered report. Zickfeld and colleagues (2021) examined participants from 41 countries, presenting them with neutral faces to which tears were digitally added (or not). The study contained four additional experimental factors, specifically, situational valence (neutral vs. positive vs. negative), target gender (female vs. male), social context (public vs. private) and target group membership (Black vs. Asian vs. Latinx vs. Middle East vs. White). Given the complex design, only the central findings are outlined here. Tears increased support intentions in all samples, but the relation was heterogeneous across countries. Exploratory analyses revealed that the association was stronger in wealthier countries that also reported higher levels of subjective well-being. This is in line with the observation that individuals report higher crying frequencies in wealthier countries (van Hemert et al., 2011), so individuals from these countries might be more familiar with tearful others. Alternatively, participants from wealthy countries might be more likely to offer help in response to crying since they possess resources they could share. Examining how the visibility of tears increases helping intentions, the strongest mediation effect was again observed for helplessness, followed by warmth. The effect was weakest but significant for connectedness. Interestingly, the authors also included an observer perspective

in their analysis by assessing empathic concern and personal distress in reaction to the tearless vs. tearful target. Empathic concern is assumed to reflect an altruistic and sympathetic reaction towards a person in need, while personal distress is associated with helping that aims to reduce one's own aversive state (McAuliffe et al., 2020). While empathic concern mediated the tear-helping intention effect, personal distress did not, suggesting that participants were mainly motivated to comfort the person in need rather than to reduce their own aversive state. Empirical work on a rather specific construct such as emotional crying can thus contribute to more general research questions. In this case, Zickfeld et al.'s (2021) findings provide another piece in the puzzle of the empathy-altruism debate (McAuliffe et al., 2020).

2.4. On the perception of crying individuals

The stereotype content model (Fiske et al, 2002) provides a well-established framework to study the question of how crying individuals are perceived by others. It postulates that social perceptions can be located along two orthogonal dimensions, namely warmth and competence (but see Imhoff & Koch, 2017, who challenge the orthogonality assumption). When a target is perceived as warm/communal, this means the observer judges the target as good-natured, trustworthy, tolerant, friendly and sincere. A target that is perceived competent/agentic is capable, skillful, intelligent, and confident (Cuddy et al., 2008). Rooted in the stereotype literature, warmth and competence ratings can refer to stereotyped social groups, such as homeless individuals (low warmth, low competence), elderly people (high warmth, low competence), homemakers (high warmth, high competence) or "the rich" (low warmth, high competence; see Koch et al., 2016, for a competing approach). However, these dimensions of social perception have been proven to come from a more general nature and they have found their way into different research areas. In the context of emotional crying, participants consistently rated pictures of targets with (vs. without) tears as warmer. While this effect could be replicated several times, the impact of tears on observers' competence perceptions is less

clear. While Van de Ven et al. (2017) found lower competence ratings for tearful (vs. tearless) targets, the results from Zickfeld and Schubert (2018) and Zickfeld et al. (2018) cast doubt on the robustness of this effect. Lower competence ratings due to tears could be observed, but only when using a certain set of stimuli or when indirect effects were considered. The inconsistent competence-effect could be explained by referring to the work of Imhoff and Koch (2017). In contrast to the classic stereotype content model, the authors assume that warmth and competence are not orthogonally but rather curvilinearly related. They found empirical support for their predictions, since high warmth was associated with average competence, while low warmth was either related to low or high competence. Put differently, when a target was perceived as warm, there was only limited variability on the competence axis. This pattern could be observed in samples from 20 different countries. Considering this general trend in the interplay of warmth and competence perceptions might explain the small and inconsistent effects when studying competence attributed to tearful targets. An alternative explanation might be that tears impact competence ratings only under certain circumstances. Fischer et al. (2013) found that men vs. women were perceived as less competent if they express tears in a work-related context. Again, considering the reason why someone is crying could be an illuminating perspective. Visibility of tears (vs. no tears) should only mildly influence observers' competence ratings when the target mourns a deceased loved one. If the target is crying for another reason, e.g., because she/he failed an exam, it is conceivable that the visibility of tears could be associated with reduced competence ratings. Future work will have to clarify which of these considerations is applicable. In summary, visibility of tears is associated with increased warmth and helplessness perceptions of the target, while the effect is less clear for competence.

2.5. Tears probably contain no chemosignal

In 2011, Gelstein and colleagues published a paper titled "Human Tears Contain a Chemosignal" in Science. The authors conducted three within-subjects experiments in which

male participants wore a pad under their nose that was either tinctured with tears obtained from female "donors" or with saline. In Study 1, the researchers found reduced attractiveness ratings of pictures of women for the "tear pad" condition. In Study 2, this condition was characterized by reduced physiological arousal and salivary testosterone levels after watching a sad movie. Study 3 revealed reduced activity of brain areas that are associated with sexual arousal for the "tear pad" condition. The authors concluded that interpersonal effects of tears are mediated not only by visual (i.e., see somebody crying) and auditory (i.e., hear somebody crying) channels, but also through an olfactory pathway (i.e., smell somebody crying). Gračanin et al. (2017) failed to find the effect in three conceptual replications, testing it in larger samples and regardless of whether they applied a between-subjects (Studies 1 and 2) or a within-subjects design (Study 3). In addition to the failed replication, Gračanin and colleagues used biological reasons to speak against an olfactory pathway in interpersonal effects of crying. The following considerations seem most relevant in this context. In contrast to the mouse genome, the human genome does not seem to code for the synthesis of pheromones in the lacrimal glands[1] (Tirindelli et al., 2009). Further, while organ structure to detect pheromones, i.e., the vomeronasal organ (VMO), is well-connected to the central nervous system in mice, humans also possess a VMO, but it is not connected to the adult brain (Tirindelli et al., 2009; Wyatt, 2015). In other words, humans seem to lack the ability to produce and to receive pheromone-mediated information via tears.

2.6. Considerations about how emotional tears might have evolved

While anecdotal evidence repeatedly suggests that animals like gorillas (Fossey, 2000) or camels (Davaa & Falorni, 2003) can shed emotional tears, a survey mostly involving veterinarians and zookeepers could not reveal any evidence for that claim (Frey, 1985).

[1] Mice seem to be able to communicate via pheromones in tears (Thompson, Napier, & Wekesa, 2007; Kimoto, Haga, Sato & Touhara, 2005).

Emotional tears seem to be extremely rare in animals, if they exist at all; however, when emotional crying is uniquely human, the question arises about how it has evolved from an evolutionary perspective. Different hypotheses have been put forward in this context. Murube (2009) and Provine (2012) both speculated that tears due to injured or infected eyes were the basis for human emotional crying. They assumed that impaired sight represents a universal signal for neediness which then became an independent and distinct option in the behavioral repertoire to ask for help. This explanation is not completely convincing because it cannot resolve why humans but no other creatures shed emotional tears. Gračanin and colleagues (2018) provided a far more stringent explanation of how crying might have evolved. Even though evolutionary explanations are post hoc in nature and could not be tested empirically, it seems appropriate to at least speculate on how this behavior might have evolved.

Gračanin et al. (2018) proposed that human emotional crying might have evolved from animal *distress calls* (see also Nelson, 1998). The offspring of many mammals and birds express vocal distress calls, for example when they are hungry. Interestingly, this behavior vanishes in adulthood in most species (dogs represent an exception), but not in humans. Acoustic distress calls seem especially important to human infants for the following reason: Human infants are extremely helpless for a relatively long period of time. While foals can walk shortly after birth, it takes about one year for humans. Given that babies largely depend on their caregivers, they need a reliable behavioral signal which ensures that they are provided with nurture, warmth and closeness. Bowlby (1969, 1980) labeled infant crying as “attachment behavior” and Ostwald (1972) used the term “acoustic umbilical cord”. In cultures where infants are most of the time carried directly next to the mother's body, they rarely or never cry vocally (Barr, 1999). However, when the baby is separated from the caregiver, distress calls offer a crucial survival advantage. Compared to visual or olfactory signals, an acoustic signal works at night, over greater distances, in the presence of visual barriers and can be variably turned on and off

(Gračanin et al., 2018). Distress calls do not, however, only pose advantages, since they can attract predators and consume ample energy. Furthermore, prolonged distress calls can also prove irritating and annoying for the caregiver, which could increase the likelihood of infanticide and child assault (Lee et al., 2007). It seems plausible that an organism that is dependent on its caregivers for so long is under evolutionary pressure to develop an alternative behavior to distress calls. Since the degree of dependency tends to decrease over time (i.e., children become more independent), it is reasonable that the alternative behavior is more subtle. Obviously, shedding tears is more subtle than expressing distress calls, since it involves less metabolic effort, is less annoying to the caregiver and is less likely to attract the attention of predators.

One could now ask whether tears are too subtle, since they are relatively small in size. However, since tears occur on the face and more specifically in the proximity of the eyes, tears can be considered as a distinctive signal. Balsters et al. (2013) demonstrated that when face stimuli were presented with (vs. without) tears, they were perceived as sadder and more needy, even though presentation time was extremely short (50ms). But how did tears come into play in the first place? Gračanin et al. (2018) proposed that shedding tears first emerged as a by-product of vocal crying. Behaviors such as vomiting or yawning can mechanically stimulate the lacrimal gland by accidentally activating the corneal sensory nerves. Given that human infants contract their face and eye muscles more strongly than other species when expressing distress calls, the by-product hypothesis seems a plausible explanation about how tearful crying might have evolved (Penbharkkul & Karelitz 1962).

2.7. Summary of the functions of emotional tears

When evaluating the available evidence, several arguments speak against the idea that tears evoke effects through a pheromone-mediated path or a kidney-like function of the lacrimal glands. The psychological functions of tears have not been conclusively clarified, but there is

convincing evidence for some assumptions. First, tears trigger the intention to help. Zickfelds' et al. (2021) examination provides evidence that this effect is a rather general phenomenon, since it can be observed in samples across the globe. Second, visibility of tears is associated with increased warmth and helplessness perceptions of the target, while the effect is less clear for competence. Third, crying seems to have a cathartic function if one refers to studies that considered relevant boundary conditions, like Gračanin et al. (2015) who captured affect-trajectories over time or like Bylsma et al. (2011) who found affective benefits in crying episodes in which the target received social support. Fourth, emotional tears might have evolved from vocal distress calls. Given the relatively long dependence of human infants on caregivers, tears can be considered as a more subtle behavioral option to signal neediness. Taken together, these findings suggest that crying serves intrapersonal and interpersonal functions, again highlighting the importance of better understanding this phenomenon.

3. PERSON-RELATED VARIABLES AND CRYING

In this chapter, the question how factors that lie in a person are related to emotional tears is discussed. Specifically, the concepts of personality traits, attachment style and depression are considered. Before entering this discussion, crying variables that are typically considered in this context will be briefly outlined.

3.1. Crying variables that are typically related to person variables

Researchers who tested the impact of person variables in the context of the cathartic thesis measured affective consequences (AC) after crying by asking participants whether they typically feel worse, the same, or better after crying (Becht & Vingerhoets, 2002). Crying duration (CD) denotes the number of minutes a crying episode lasts (Becht & Vingerhoets, 2002). Crying intensity (CI) captures whether crying was not at all, somewhat, or absolutely intense (Becht & Vingerhoets, 2002). Crying frequency (CF) is defined as the number of crying episodes within a certain period. Predominantly, participants are instructed to refer their ratings to a four-week period (Peter et al., 2001), but some studies used longer periods, e.g., one year (Fiori et al., 2017). De Fruyt (1997) applied an alternative definition of CF as he instructed participants to fill in part A of the Adult Crying Inventory (ACI; Becht & Vingerhoets, 2002), which contains 55 descriptions of situations in which people might cry. He interpreted participants' proneness to cry in reaction to those hypothetical situations as CF. Crying proneness (CP) is usually defined as the general tendency to cry (Denckla et al., 2014). Participants were either asked to refer their ratings towards specific reasons, e.g., negative triggers (CP_{neg}) or positive triggers (CP_{pos}), or to rate CP_{gen} in general (Fiori et al., 2017). Crying proneness can be viewed critically for several reasons. First, the empirical relations between CP and personality traits are inconsistent. Peter et al. (2001) found a positive correlation for neuroticism to CP_{neg}, CP_{pos}, and CP_{gen}, while extraversion was positively related to CP_{neg}. Rottenberg et al. (2008b) observed a positive correlation from extraversion to CP_{neg} but also to

CP_{pos}, while neuroticism was only positively related to CP_{pos}. Second, Nisbett and Wilson (1977) demonstrated that people can only to a limited degree provide information about their actual behavior. Ratings of hypothetical behavior might be even more problematic. Third, a satisfying location of CP in a nomological network is missing. Even though Denckla and colleagues (2014) examined the relation from CP to empathy, attentiveness, and age, it remains unclear whether CP can be distinguished from already established concepts such as emotion regulation (Gross, 2015) or emotionality (Ashton & Lee, 2007). Based on these considerations, CP is not examined in my empirical work.

3.2. Study 1 – On the relation between crying and personality traits

The following part of the chapter corresponds to the article *Adult Emotional Crying: Relations to Personality Traits and Subjective Well-Being* which was published in *Personality and Individual Differences* (Barthelmäs & Keller, 2021).

3.2.1. Theory

Emotional crying represents a specific form of human emotion expression and can be associated with different emotions, such as rage, elation, or sadness (Vingerhoets et al., 2000). The role of personality traits has been examined early on in this context (e.g., de Fruyt, 1997) and neuroticism has been identified as most relevant concept, since positive correlations to crying frequency (i.e., how often does someone cry?) have been observed repeatedly (de Fruyt, 1997; Peter et al., 2001; Rottenberg et al., 2008b). However, the picture is less clear for other traits. The present work therefore aims at a better understanding of the phenomenon of emotional crying. First, we want to replicate the positive correlation between crying frequency and neuroticism. Second, we explore the associations between personality traits and different aspects of emotional crying by drawing on current developments in the conceptualization of personality (Ashton & Lee, 2007; Knežević et al., 2017). Third, we examine whether and for

whom crying is beneficial, thereby touching upon a prominent idea in psychology, the catharsis thesis.

Relation between crying frequency and personality. While different researchers consistently reported on a positive relation between neuroticism and crying frequency (de Fruyt, 1997; Peter et al., 2001; Rottenberg et al., 2008b), the relation between other traits and crying is less clear. Rottenberg et al. (2008b) found no association between extraversion and crying frequency, while de Fruyt (1997) reported a negative (but not significant) correlation. However, Peter et al. (2001) found a positive relation in a regression analysis, but not in a correlation analysis. No relation between agreeableness and crying frequency was found in de Fruyt (1997), whereas Peter et al. (2001) found a positive relation in a regression analysis, but not in a correlation analysis. No relation to crying frequency was observed for conscientiousness (de Fruyt, 1997; Peter et al., 2001) and openness (de Fruyt, 1997).

The heterogeneous findings can be interpreted in different ways. While Rottenberg et al. (2008b) and Peter et al. (2001) measured crying frequency with one item from the Adult Crying Inventory (ACI; Becht & Vingerhoets, 2002), which asks participants to indicate how often they cried during the past four weeks, de Fruyt (1997) used a measure comprising 55 items asking respondents to indicate whether they typically cry in the context of certain situations and emotions. He defined crying frequency as the sum score across these items, an approach that is very different from the one used by Rottenberg et al. (2008b) and Peter et al. (2001). Another interpretation of the heterogeneity is that the empirical basis of the mentioned studies is not substantial, since the examined samples were relatively small, which can lead to methodological problems such as overfitting of regression models (Babyak, 2004). Additionally, the applied inventories to measure personality omitted potentially relevant traits[2]. We therefore explore the

[2] de Fruyt, 1997: N = 105, considered traits: neuroticism, extraversion, openness, conscientiousness, agreeableness; Peter et al., 2001: N = 104, considered traits: autonomy,

relation between crying and personality in a well-powered study relying on a comprehensive conceptualization of personality. Specifically, we rely on measures of the HEXACO model (Ashton & Lee, 2007) plus *disintegration* (proneness to psychotic-like experiences; Knežević et al., 2017) to assess personality.

Based on a lexical approach, the HEXACO model postulates six dimensions. The main difference to a Big Five structure of personality is the inclusion of the Honesty-Humility factor. Ashton and Lee (2007) stated, that "Honesty-Humility represents the tendency to be fair and genuine in dealing with others, in the sense of cooperating with others even when one might exploit them without suffering retaliation" (p. 156). Recent evidence suggests that a seventh factor that captures *psychotic tendencies* might be considered when assessing personality traits (Ashton & Lee, 2020; Međedović, 2014). We therefore complement our assessment of personality with a scale to measure *disintegration* (Knežević et al., 2017). The personality trait disintegration conceptualizes proneness to psychotic-like phenomena ranging from subclinical to clinically relevant manifestations (Knežević et al., 2016). Manifestations of disintegration are presumed to be grounded in disintegrated information processing, resulting in distorted cognitions, emotions and behavior (Knežević et al., 2016).

With regard to relations between crying frequency and personality traits, we put forward the following hypotheses. Hypothesis 1: Referring to the above-mentioned findings, we expect a positive relation between emotionality and crying frequency. Hypothesis 2: Assuming that higher degrees of disintegration are associated with less capacity for reflective emotion regulation (Međedović & Knežević, 2019), we assume that higher levels of disintegration are associated with higher crying frequency. Given the inconsistency of findings (extraversion and agreeableness), the lack of prior work (honesty-humility) and empirical null-effects

neuroticism, extraversion, conscientiousness, agreeableness; Rottenberg et al., 2008b: N = 196, considered traits: extraversion and neuroticism.

(conscientiousness and openness), we put forward a priori hypotheses for emotionality and disintegration and examine the other relations exploratively.

Relation between crying, subjective well-being and personality. As explained at the outset, the current work aims to examine whether and for whom crying may be beneficial. We address this issue applying two approaches. First, we examine how personality traits are related to affect- and arousal-changes after crying (i.e., do individuals feel more positive/calm, more negative/aroused or largely the same after crying?). Prior studies revealed mixed evidence when relating personality traits to affect-changes after crying. While de Fruyt (1997) found that extraversion was associated with positive affect-changes after crying, neither Rottenberg et al. (2008b), nor Peter et al. (2001) found such a relation. But again, the assessment differed between the studies. While de Fruyt (1997) relied on a sum score of items describing potential positive effects of crying, Rottenberg et al. (2008b) and Peter et al. (2001) instructed participants to rate seven adjectives indicating how they typically feel after crying (e.g., happy) with three categories: less, same, or more (cf. Becht & Vingerhoets, 2002). The limitation to three response categories, only allowing relatively extreme ratings, could be a methodological explanation for the fact that the two studies did not reveal any relation between personality traits and affect-change after crying (cf. Preston & Colman, 2000). Another possible explanation is that this assessment does not specify the point in time after crying. However, this is a very important aspect as immediate affect largely differs from long-term affect after crying. Gračanin and colleagues (2015) found in a quasi-experimental study that immediate affect was worse compared to baseline, while affect 90 minutes after crying was even better than during baseline. Accordingly, we apply a novel measure with more fine-grained answer categories to assess affect- and arousal-changes after crying, which additionally specifies the point in time after crying to which participants should relate their report.

In our second approach, we relate crying to measures of subjective well-being, namely the WHO-5 well-being index (WHO-5; Topp et al., 2015) and the Satisfaction with Life Scale (SWLS; Diener et al., 1985). The relation between crying and indicators of subjective well-being is less straight forward than one may assume, as the available findings point in different directions (see Rottenberg et al., 2008a and Vingerhoets et al., 2000 for reviews). While Rottenberg et al. (2002) found that patients suffering from mood disorders cried more frequently and experienced less positive affect-change after crying than healthy controls, Steer (2011) revealed that depressed patients who reported to be unable to cry, suffered from more severe depressive symptoms than depressed patients who could cry. In non-clinical samples, individuals who were unable to cry reported similar levels of subjective well-being compared to individuals who could cry, even though non-criers reported to be less connected to others and to experience less social support (Hesdorffer et al., 2018). However, Schlosser (1990) found a negative relation between crying frequency and well-being. Given the mixed evidence for both approaches, we remain neutral regarding the relation between crying and subjective well-being. Accordingly, these relations will be examined exploratively.

The present study. In our study, we relate different aspects of emotional crying to measures of personality by drawing on current developments in the conceptualization of personality. The study contains confirmatory elements (see Hypothesis 1 and 2) and explorative features (e.g., the relation between affect-change after crying and honesty-humility).

3.2.2. Materials and Methods

The study was approved by the local ethics committee. All Participants agreed to an informed consent and received 1.50€ (approx. 1.50$) as compensation. Data of the study is available on the OpenScienceFramework (https://osf.io/r783s/). The pre-registration form is available under https://aspredicted.org/gv4ux.pdf. We report on all measures, conditions, data exclusions and how we determined sample size.

Sample. Participants were recruited via the crowdsourcing platform Clickworker. Assuming an effect size of r = .20 for the correlation between emotionality/neuroticism and crying frequency (Rottenberg et al., 2008b) and a power of 0.9 (alpha = 0.05), a sample size of N = 258 is required (bivariate correlation; GPower, Faul et al., 2009). Rottenberg and colleagues (2008b) limited their sample to female participants. Given the evidence documenting gender differences in emotional crying (e.g., de Fruyt, 1997) and considering that we did not have a reference for the effect size between disintegration and crying frequency, we decided to at least double the desired sample size. The final sample comprised N = 622 participants (238 women, 382 men, 2 divers; M_{age} = 38.70, SD_{age} = 12.70, $range_{age}$ = 18 – 75; in relationship = 349, no relationship = 273).

Procedure. We asked participants to indicate how often they had cried during the last four weeks and to report on typical affect- and arousal-changes after crying. Next, participants filled in the HEXACO Personality Inventory (Ashton & Lee, 2007), a scale measuring disintegration (Knežević et al., 2017), the SWLS (Diener et al., 1985) and the WHO-5 (Topp et al., 2015). Finally, demographic variables were assessed (age, gender and relationship status). Unless otherwise stated, all responses were given on 7-point Likert scales ranging from “I completely disagree” to “I completely agree”. Internal consistencies are depicted in Table 1. The study contained two attention-check items. Participants were excluded from the study if they answered one of these items incorrectly.

Crying. Crying frequency was measured with one item from the ACI (Becht & Vingerhoets, 2002): „How often did you cry during the last four weeks?” As explained in the introduction, we used a novel measure to assess affect- and arousal-changes after crying. In parallel to the measures applied by Rottenberg et al. (2008b) and Peter et al. (2001), we instructed participants to rate their state after crying using a scale with three anchors (cf. Becht & Vingerhoets, 2002). However, our measurement differed with respect to three aspects. First,

we provided participants with a temporal context to which they should relate their rating. By instructing respondents to rate their state two hours or longer after crying, we aimed to capture long-term (and not immediate) effects of crying. Prior research suggests that positive affective consequences of crying are more likely to occur in the long run, while immediate affect following crying is typically more negative (Gračanin et al., 2015). Second, we provided participants with a 9-point Likert-scale, which allowed for more fine-grained affect- and arousal-ratings by participants. Preston and Colman (2000) found that such scales have better properties in terms of validity than scales with only three response categories. Third, we let participants rate their state after crying on the core dimensions underling affective states, i.e., affect and arousal (cf. Russell, 1980). Specifically, we applied Self-Assessment Manikins (SAMs, see Figure 2), which is a commonly used and validated strategy to assess affect and arousal in an efficient way (Bradley & Lang, 1994).

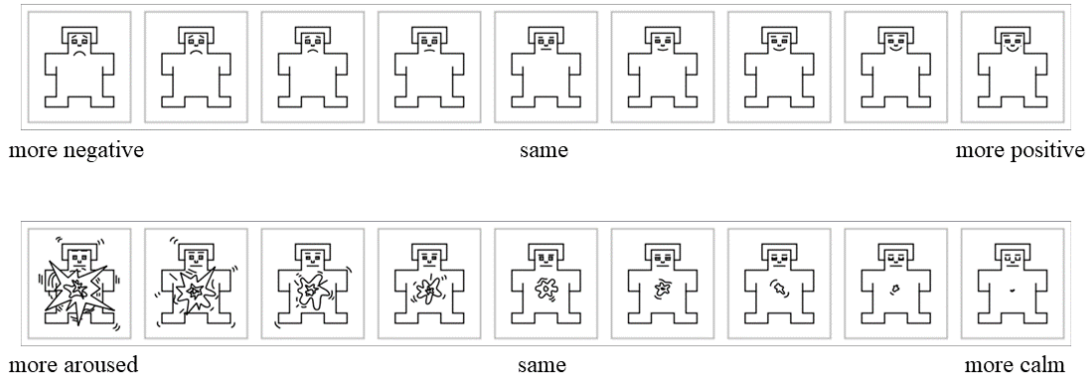

Figure 2. Self-Assessment Manikins to assess valence (upper part) and arousal (lower part). The left pole is coded with 1, the right pole with 9 and the middle with 5 (Barthelmäs & Keller, 2021).

HEXACO. We used the 60-item version of the HEXACO Personality Inventory-Revised (HEXACO-60; Ashton & Lee, 2007) to assess the HEXACO personality model. The HEXACO-60 consists of 10 items for each of the six HEXACO scales.

Disintegration. DELTA (Knežević et al., 2017) – a 20-item measure of *Disintegration* was applied. Sample items read “Sometimes, while doing something, I experience a mental

block, because my mind turns blank" and "On occasion, when I'm about to say something I end up saying something completely different."

Subjective well-being. We used the SWLS (Diener et al., 1985) to assess the cognitive component of subjective well-being with 5 items (sample item: „In most ways my life is close to my ideal"). We used the WHO-5 from Topp and colleagues (2015) to assess the affective/eudaimonic component of subjective well-being with 5 items (sample item: „I have felt cheerful in good spirits"). For the WHO-5 the anchors 1 = "at no time" and 7 = "at all time" were used.

Analysis strategy. For our confirmatory analyses, we correlated crying frequency with emotionality and disintegration. Crying frequency was not normally distributed (see Figure 3). Therefore, we also calculated Spearman correlation coefficients and winsorized the variable (see Appendix A). Non-parametric and winsorized results were very similar to results reported in the present article.

In our explorative analysis, we correlated crying frequency, affect- and arousal-change after crying, the HEXACO, disintegration, SWLS and WHO-5. Independent sample t-tests were used to explore gender- and relationship status-differences for the crying variables. One-sample t-tests were used to test whether means for affect- and arousal change differed from the scale-midpoints. We used the Omega macro from Hayes and Coutts (2020) to calculate McDonald's omega (ω) as indicator of internal consistency.

3.2.3. Results

Descriptive analysis. Crying frequency was right skewed, as 262 participants did not report a single crying episode. The distribution and the descriptive statistics are depicted in Figure 3. Descriptive statistics for all other variables of the study are depicted in Table 1.

Confirmatory analysis. As predicted, emotionality and disintegration were positively correlated with crying frequency (see Table 1).

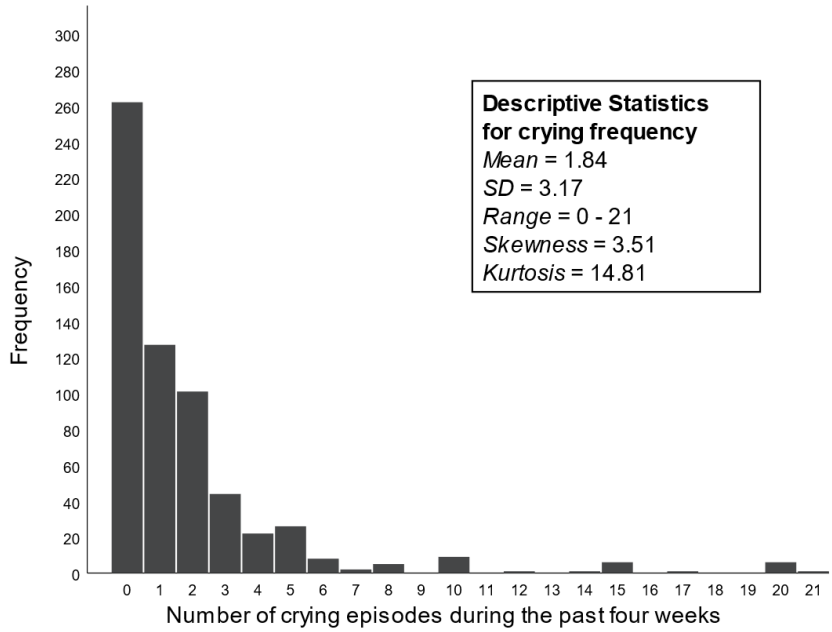

Figure 3. Histogram for crying frequency (Barthelmäs & Keller, 2021).

Explorative analysis.

Crying Frequency. Regarding the other personality traits, extraversion and agreeableness were negatively associated with crying frequency. In addition, WHO-5 and SWLS were negatively related with crying frequency. Crying frequency was not correlated with affect- and arousal-change.

Women reported more than twice as many crying episodes than men, $t(618) = 7.38$, $p < .001$, $d = 0.57$, $M_{\text{women}} = 2.98$ (*SD = 4.06*), $M_{\text{men}} = 1.13$ (*SD* = 2.19). Crying frequency seemed not to differ with regard to relationship status, $t(620) = 1.31$, $p = .190$, $d = 0.11$; $M_{\text{relationship}} = 1.69$ (*SD* = 2.78); $M_{\text{no relationship}} = 2.03$ (*SD* = 3.61).

Affect- and arousal change after crying. Honesty-humility, extraversion, agreeableness and openness were correlated with positive affect-change after crying, while disintegration was related with negative affect-change. WHO-5 and SWLS were correlated with positive affect-change. Honesty-humility, agreeableness and openness were correlated with arousal-change (in direction of calmness) after crying. WHO-5 and SWLS were not correlated with arousal-change.

On average, participants reported to feel more calm and more positive after crying (comparing means to the scale-midpoints), $t(621)_{arousal} = 19.58$, $p < .001$, $d = 0.78$; $t(621)_{affect} = 9.07$, $p < .001$, $d = 0.36$ (see Table 1 for descriptive statistics). Affect- and arousal-change did not seem to differ with respect to gender[3] or relationship status[4].

[3] Affect: $t(618) = -.98$, $p = .326$, $d = 0.08$; $M_{women} = 5.72$ ($SD = 1.63$); $M_{men} = 5.58$ ($SD = 1.81$); arousal: $t(618) = 1.28$, $p = .201$, $d = 0.11$; $M_{women} = 6.44$ ($SD = 1.76$); $M_{men} = 6.26$ ($SD = 1.66$).

[4] Affect: $t(620) = 0.01$, $p = .997$, $d = 0.00$; $M_{no\ relationship} = 5.63$ (1.73); $M_{relationship} = 5.63$ (1.75); arousal: $t(620) = -0.83$, $p = .407$, $d = 0.06$; $M_{no\ relationship} = 6.27$ (1.66); $M_{relationship} = 6.38$ (1.73).

Table 1. *Zero-order correlations between all scales of the study (Pearson correlation coefficients).*

		Correlations (*p-values*) [*BCa 95% CI*]										
	M (SD)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1)Crying frequency	1.84 (3.17)	-.025	.038	.037	**.298**	-.219	-.103	-.029	.004	**.143**	-.286	-.231
		(.527)	(.348)	(.360)	**(<.001)**	(<.001)	(.010)	(.463)	(.924)	**(<.001)**	(<.001)	(<.001)
		[-.11; .06]	[-.05; .13]	[-.05; .13]	**[.21; .38]**	[-.31;-.13]	[-.19;-.01]	[-.11; .05]	[-.09; .10]	**[.05; .24]**	[-.36;-.21]	[-.31;-.15]
(2)Affect-change	5.65 (1.67)	1	.551	.166	.002	.175	.170	.065	.097	-.099	.172	.149
			(<.001)	(<.001)	(.962)	(<.001)	(<.001)	(.104)	(.015)	(.014)	(<.001)	(<.001)
(3)Arousal-change	6.36 (1.72)		1	.161	-.038	.075	.182	.057	.153	-.069	.075	.051
				(<.001)	(.339)	(.061)	(<.001)	(.157)	(<.001)	(.086)	(.062)	(.205)
(4)Honesty/Humility	4.79 (0.92)			1	-.006	.007	.246	.281	.259	-.360	.051	.104
ω = .74					(.0879)	(.870)	(<.001)	(<.001)	(<.001)	(<.001)	(.205)	(.009)
(5)Emotionality	4.11 (0.91)				1	-.266	-.226	.025	.014	.136	-.270	-.209
ω = .76						(<.001)	(<.001)	(.541)	(.721)	(.001)	(<.001)	(<.001)
(6)Extraversion	4.04 (0.92)					1	.320	.072	.097	-.308	.579	.621
ω = .78							(<.001)	(.072)	(.016)	(<.001)	(<.001)	(<.001)
(7)Agreeableness	4.25 (0.71)						1	-.025	.097	-.176	.257	.255
ω = .63								(.537)	(-015)	(<.001)	(<.001)	(<.001)
(8)Conscientiousness	4.84 (0.81)							1	.219	-.448	.148	.174
ω = .75									(<.001)	(<.001)	(<.001)	(<.001)
(9)Openness	4.53 (0.91)								1	-.127	.073	.022
ω = .73										(.001)	(.069)	(.581)
(10) Disintegration	2.65 (1.07)									1	-.338	-.313
ω = .93											(<.001)	(<.001)
(11) WHO-5	4.17 (1.30)										1	.668
ω = .91												(<.001)
(12) SWLS	4.19 (1.38)											1
ω = .91												

Notes. BCa 95% CI = Bias corrected accelerated Confidence Intervals, bootstrap results are based on 2000 bootstrap samples; ω = McDonald's omega; WHO-5 = WHO-5 Well-Being Index, SWLS = Satisfaction with Life Scale, in bold = results concerning a priori Hypotheses.

3.2.4. Discussion

Current conceptualizations of emotional crying assume that whether a person cries or not depends on various factors such as context features, like the presence of others (Bylsma et al., 2011), and psychosocial factors, like gender (de Fruyt, 1997) and personality (Vingerhoets et al., 2000). In the present work, we aimed to enhance our understanding of how personality traits relate to human emotional crying, since former studies left some questions open in this context. In our confirmatory analysis, we replicated a (large[5]) positive relation between emotionality and crying frequency (cf. de Fruyt, 1997; Peter et al., 2001; Rottenberg et al., 2008b). As predicted, we found a (small) positive relation between crying frequency and disintegration, a personality trait that has so far not been related to crying.

Our explorative analysis revealed several interesting findings. We found negative correlations of crying frequency with extraversion (medium) and agreeableness (small). This is remarkable, since former studies revealed mixed results in this respect (de Fruyt, 1997; Peter et al., 2001; Rottenberg et al., 2008b). In addition, we found a negative association between subjective well-being and crying frequency (medium), which is in line with Schlosser (1990). Consistent with former studies, women reported higher crying frequency than men (de Fruyt, 1997). In contrast to former work (Fiori et al., 2017), we found no relation between relationship status and crying frequency.

Compared to former studies, we applied an alternative approach to assess affect- and arousal-changes after crying. On average, emotional crying was followed by more positive affect and less arousal, pointing at a potential cathartic effect of emotional crying (Bylsma et al., 2011). Regarding the correlations involving affect-change, we found more positive affective consequences of crying the higher individuals scored on honesty-humility, agreeableness, openness and extraversion (all small). Interestingly, the latter finding is in line with de Fruyt

[5] Funder and Ozer (2019): $r = .10$ – small, $r = .20$ – medium, $r = .30$ – large.

(1997), even though the assessment of affect-change after crying was quite different (see introduction). Disintegration was negatively correlated with positive affect-change, while WHO-5 and SWLS were associated with positive affect-change (all small). Honesty-humility, agreeableness and openness were associated with arousal-change (in direction of calmness; all small). Using a broader response scale (Preston & Colman, 2000), specifying a temporal reference (Gračanin et al., 2015) and approaching affect- and arousal-changes with pictograms might explain why we were able to detect relations to personality traits, which have been so far unrevealed.

As we report on correlational data, we can only speculate on the mechanisms underlying the observed relations. Emotionality and disintegration might be related to increased crying frequency because highly (vs. slightly) emotional/disintegrated individuals tend to have only limited emotion regulation skills or capacity (Yoon et al., 2013). Alternatively, emotional/disintegrated individuals might simply be confronted with crying eliciting situations more frequently than their low emotional/disintegrated counterparts (Magnus et al., 1993). Similarly, extraversion might be negatively related to crying frequency, as extraverted (vs. introverted) individuals encounter less triggers for crying in their everyday lives (Magnus et al., 1993). However, it is also plausible that extraverted persons can rely on more effective coping and emotion regulation strategies than introverted individuals and therefore cry less frequently (Hughes et al., 2020).

Considering the relation between extraversion and affective consequences of crying, it may be the case that a crying episode appears to be less threatening for the self-concept of highly (vs. slightly) extraverted individuals because they typically feel positive about themselves, which might buffer against negative affective consequences of crying (Magnus et al., 1993). Characterized by low ambitions to protect or elevate their social status, individuals scoring high (vs. low) on honesty-humility might benefit from crying as they are less concerned about losing

reputation or status when crying in the presence of others (Ashton & Lee, 2007). Finally, one may argue that highly (vs. slightly) agreeable persons tend to be confident to cope with crying episodes in a way that results in positive affective consequences and reduced arousal (Barańczuk, 2019).

Limitations. Since we asked participants to report on crying episodes that occurred during the last four weeks, our main dependent variables might be distorted by retrospective biases. Especially, the measures for affect- and arousal-changes, which refer to the affect/arousal two hours or longer after crying, are at risk to be distorted by such biases. Future studies should therefore make use of diary techniques to minimize such risks (Bylsma et al., 2011). Nevertheless, we suppose that crying episodes are quite remarkable experiences for most respondents - since they are typically associated with strong emotions - and accordingly we are confident that a heavy misrepresentation of these episodes in memory is much less likely than it is true for other kinds of episodes. Even though our sample is more diverse in terms of age range than is the case when recruiting undergraduate students only, our sample is not representative, which limits the generalizability of our results. Given the large effect of the relation between crying frequency and emotionality as well as the high internal consistency for the applied disintegration measure, our sample size can be evaluated as sufficient to examine our hypotheses (cf. Kretzschmar & Gignac, 2019). However, future work trying to replicate our findings should study representative samples and should ensure decent sample sizes when focusing on weaker relations or when scales with lower internal consistency are involved (e.g., agreeableness).

Conclusion. Taken together, extraverted and individuals with high levels of well-being reported to cry less frequently than their introverted / low well-being counterparts, while emotional and disintegrated individuals indicated to cry more frequently than their respective counterparts. Honest, extraverted, agreeable and individuals with high levels of well-being

reported to benefit from crying. In sum, the present study indicates that human emotional crying is not only related to emotionality (or neuroticism) but to a set of traits, depending on which aspect of crying is in the focus of attention.

This part of the chapter corresponded to the article *Adult Emotional Crying: Relations to Personality Traits and Subjective Well-Being* which was published in *Personality and Individual Differences* (Barthelmäs & Keller, 2021).

3.3. On the relation between crying and attachment style

Attachment style is the second trait-like construct that has received attention in the context of crying. Attachment theories assume that individuals generate experience-based working models about interpersonal relationships across their lives. These working models provide orientation in social situations (e.g., Mikulincer & Shaver, 2007), and it is assumed that the content of these models can be located along two independent dimensions, namely attachment avoidance and attachment anxiety (Fairchild & Finney, 2006). The former concept describes a negative view of others and the suppression of emotions in relationships (sample item: „I don't feel comfortable opening up to others", Fraley et al., 2000). The latter mainly describes a negative view of the self in the context of relationships (sample item: „I worry that others won't care about me as much as I care about them", Fraley et al., 2000). Four attachment styles can be differentiated: secure (low avoidance, low anxiety), preoccupied (low avoidance, high anxiety), fearful (high avoidance, high anxiety), and dismissing (high avoidance, low anxiety; Bartholomew & Horowitz, 1991).

As one would expect, dismissively attached individuals reported lower CF (Bartholomew & Horowitz, 1991) and lower CP (Laan et al., 2012). Dismissively attachment individuals reported shorter CD and lower CI when crying in reaction to music (Laan et al., 2012). Individuals with a preoccupied and fearful (vs. secure) attachment style reported more negative emotions while crying and higher CP_{neg}. Further, preoccupied (vs. secure) attached

individuals reported higher CI in reaction to music (Laan et al., 2012). Fiori and colleagues (2017) found a positive relation between attachment anxiety and CF, while attachment avoidance was associated with low CF for individuals in a romantic relationship. CP_{gen} was negatively associated with attachment avoidance and positively associated with attachment anxiety. Given that previous studies have already revealed clear relations between attachment style and crying, this relation was not investigated in my empirical work.

3.4. On the relation between crying and mental diseases

Screening the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (American Psychiatric Association, 2013) for the keywords "tear" and "cry" yielded several hits. One cardinal symptom of a major depressive episode is fulfilled when a depressed mood for most of the day, nearly every day (within a 2-week period), is self-reported by a patient or observed by others, e.g., when the patient "appears tearful" (p. 125). Tearfulness is also a diagnostic criterion for an adjustment disorder (with depressed mood) and for a premenstrual dysphoric disorder. When considering the "Diagnostic Features" sections, where diagnostic criteria are outlined in more detail, crying is described as a reaction towards criticism in patients suffering from avoidant personality disorder. Further, frequent crying can be evaluated as a sign of intense sorrow and emotional pain in the context of a persistent complex bereavement disorder. Crying can also occur during sleep terror, which is defined as recurrent episodes of abrupt terror arousals from sleep. Lastly, the DSM 5 allows interpreting crying in children as a sign for anxiety (e.g., in social phobia) or distress (e.g., in gender dysphoria). Given that the presence of tears is mainly considered as diagnostic criterion for affective disorders, the relation between crying and depression is discussed in the next paragraph.

3.4.1. Crying in depression

Most work examining crying in a clinical context has focused on the relation between depression and tears (see Vingerhoets et al., 2007, for a review). The Beck Depression

Inventory-II (BDI-II; Kühner et al., 2007) is one of the most frequently used screening tools to assess depression severity, and it suggests a curvilinear relation between crying and depression. Of 21 items, one asks respondents to indicate how their crying behavior has changed within the last two weeks. Four options are available: (0) „I don't cry any more than usual"; (1) „I cry more now than I used to"; (2) „I cry all the time now"; and (3) „I used to be able to cry, but now I can't cry even though I want to". Hence, indicating that CF is higher than usual (i.e., options 1 and 2) is related to mild and moderate depression severity. Selecting option 3 is interpreted as the most severe manifestation (see Patel, 1993, 2001, for a similar view) and in alignment was Steer (2011), who found that clinically depressed outpatients suffered from more severe depression when choosing option 3 (compared to the other options). Santor and Ramsay (1998) as well as Rottenberg et al. (2002) found similar results in their clinical samples[6]. Further, Vingerhoets et al. (2007) reported a robust positive correlation (r = .40 on average) between the BDI-II crying item and the sum score of the BDI-II in different studies considering clinical and non-clinical samples. Vingerhoets et al. (2007) did not interpret this finding as support for the curvilinear relation between CF and depression. Given that the crying item is *non-linearly coded* (see Figure 4), the correlation analysis can be interpreted as a test for the curvilinear relation between CF and depression severity. While Vingerhoets et al. (2007) concluded that "[c]urrent claims about the relationship between depression and crying lack a robust empirical foundation" (abstract), I propose to be less reluctant to interpret the existing empirical findings in terms of a U-shaped relationship.

[6] Kraemer and Hastrup (1986) found no relation between crying frequency and depression severity in a student sample. However, participants reconstructed their crying frequency for a period of one year, suggesting that these ratings could be altered by recall biases. Furthermore, crying frequency was not treated as continuous variable in the analyses but was artificially divided into three groups, limiting the power of the related tests (see Altman & Royston, 2006).

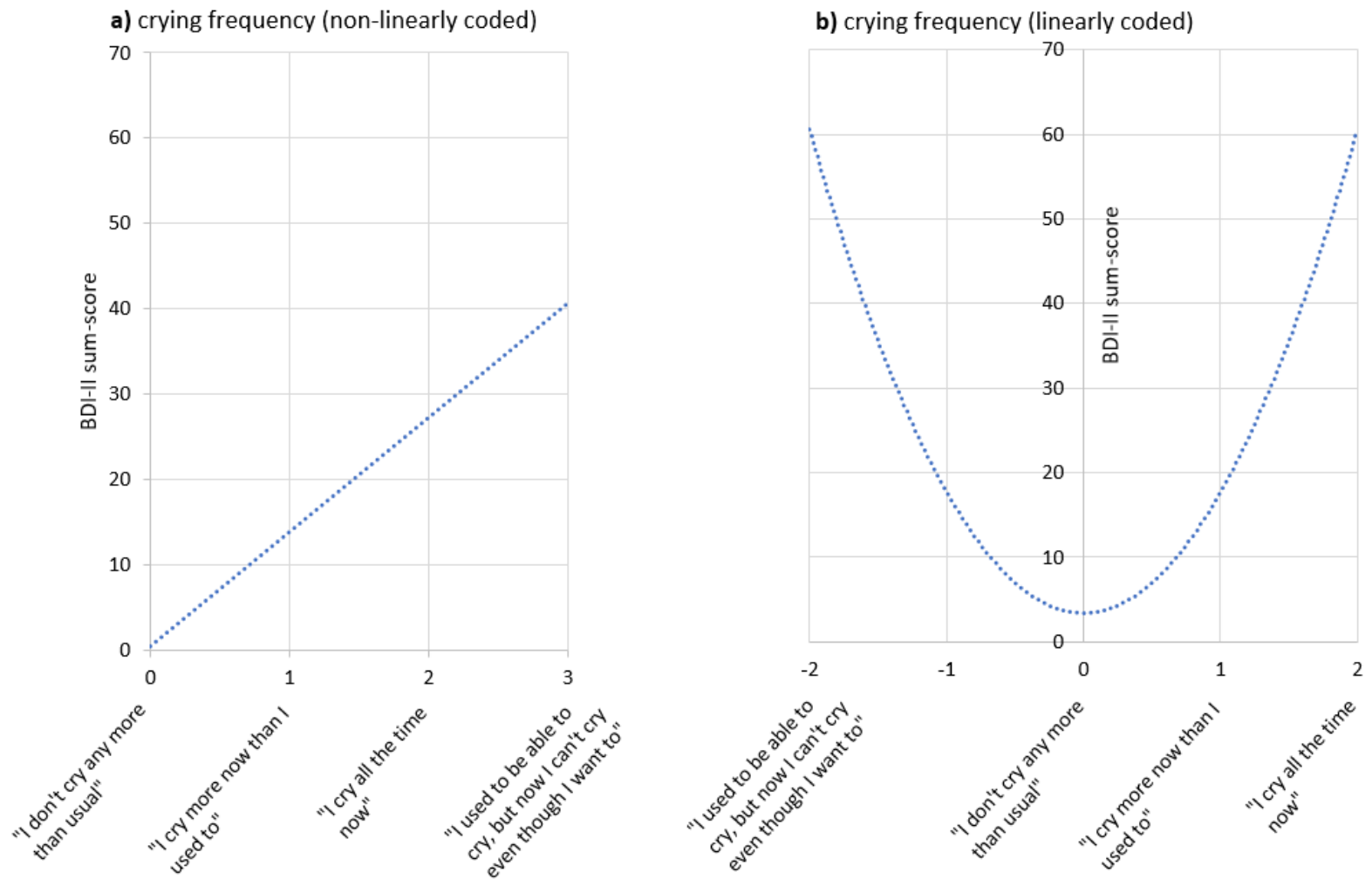

Figure 4. Prototypical relation between crying frequency and BDI-II sum-score; a = crying frequency non-linearly coded; b = crying frequency linearly coded

To support this argument, I re-analyzed two randomly selected open data sets in which the BDI-II was measured. In non-clinical convenience samples from Germany (n=410, 295 females, 115 males; Reuter et al., 2020) and Brazil (n=354, 284 females, 70 males; Freitas et al., 2018), evidence in support of my interpretation was found. When the BDI-II total score (crying item not included) was plotted on the y-axis and the crying item on the x-axis (linearly coded: -2=unable to cry; 0 =no change; 1=increased crying; 2=permanent crying; see Figure 4b), a U-shaped relation emerged. Regression models, which included the crying item as a linear and a quadratic term explained 28% of the variance in BDI-II in the German sample, $F(2,409) = 80.69$, $p < .001$, and 48% in the Brazilian sample, $F(2,353) = 164.05$, $p < .001$. The model fit did not change when the option "unable to cry" was coded with -3 instead of -2, hence analysis of the open data sets does not lead to the conclusion that non-crying is associated with more severe depression than permanent crying. However, coding "unable to cry" with -1 resulted in worse model fits ($\Delta R^2_{Barzil} = .09$ and $\Delta R^2_{Germany} = .01$).

In sum, these results suggest that the relation between CF and depression is curvilinear rather than linear, which is well in line with former theorizing (e.g., Beck, 1967). Depression could be either associated with more (Frey et al., 1983; Rottenberg et al., 2002) or less crying (e.g., Steer, 2011). While clinical studies provide evidence that being unable to crying is associated with more severe symptoms (e.g., Rottenberg et al., 2002), the open data sets do not allow a clear conclusion in this respect. Interestingly, screening instruments besides the BDI-II typically do not assess whether patients cry less than usual (see Vingerhoets et al., 2007). The same applies to the DSM 5, since only the presence (not the absence) of crying/tears is mentioned as a diagnostic criterion. In view of the findings described above, it is worth considering whether the lack of crying should receive more attention in the clinical context.

One can speculate about the determining factors leading to a "dry" or a "wet" depression. Four hypotheses have been put forward in this context. First, gender could be a relevant variable,

since it was demonstrated that female patients suffering from depression were observed to cry more often than men (Okada,1991), and females self-reported higher CF than men (Carter et al., 2000). Unfortunately, this assumption could not be tested in the open data sets, since only a small number of male participants were tested. In general, women tend to cry more frequently, more intensively and more easily than men (De Fruyt, 1997; Peter et al., 2001; Vingerhoets & Scheirs, 2000). But gender could explain only little variance in affect change after crying (Becht & Vingerhoets, 2002). Second, Keller and Nesse (2006) suggested that the potential trigger of a depressive episode might be relevant to disentangle whether crying frequency increases or decreases. Supporting their assumption, the authors found that depression in reaction to a social loss was more likely related to increased CF than to depression in the context of personal failure. In the bigger picture, these results are well in line with the social signal hypothesis. As described above, tears can be understood as a signal asking for social support. Thus, shedding tears in reaction to a social loss could be evaluated as a functional behavior to reestablish a connection to others (see Bylsma et al., 2021, for a similar view). A third assumption claims that the relation between crying and depression might be qualified by trait-like characteristics, such as attachment style. Nelson (2005) assumes that dismissively attached patients might reduce their attachment behavior under depression, while the opposite is assumed for patients with a preoccupied attachment style. The following findings might be consistent with this assumption. Patients suffering from affective disorders or from anxiety disorders reported less affective improvement after crying compared to healthy controls (Rottenberg et al., 2008a, Rottenberg et al., 2008b: Vingerhoets et al., 2007). Fourth, it was suggested that severe depression might be associated with less crying due to the intake of selective serotonin reuptake inhibitors (SSRIs), which are assumed to reduce crying frequency (Bylsma et al., 2021).

3.5. Summary of the relation between crying and person-related variables

Summing up the main results for the relation between person variables and crying suggests that extraverted individuals cry less frequently than their introverted counterparts, while emotional and disintegrated individuals cry more frequently than their respective counterparts. Further, indicators of subjective well-being were negatively correlated with crying frequency. Honest, extraverted, agreeable individuals seem to benefit from crying. Attached avoidance seems to be negatively associated with CF, while attachment anxiety is positively related to CF. While the DSM 5 considers tearfulness a cardinal symptom of depression, the available evidence suggests a curvilinear relation between crying and depression: Depression can be related to an increase of crying frequency, but some individuals seem to lose their ability to shed emotional tears during depressive episodes. An explanation of when which case occurs is still pending.

4. SITUATIONAL VARIABLES AND CRYING

Darwin (1872/1998) noted that emotional tears can be related both to suffering and to tender feelings; thus, emotional crying could occur in the context of positive and negative affect. Probably the most influential hypothesis concerning the antecedents of emotional crying is the so-called helplessness hypothesis, which assumes that crying is triggered in uncontrollable situations. While this claim could be partially supported by Vingerhoets et al. (1997), showing that crying due to negative triggers was often paired with feelings of helplessness, the hypothesis reaches its limits when it comes to tears in the context of positive affect. Even though attempts have been made to rationalize why tears of joy should also be associated with helplessness, these efforts are not entirely convincing. Gračanin et al. (2018), for example, proposed that tears in the context of overwhelming joy or elation might be triggered by the insight of the crying individual that her/his emotional reaction is no longer controllable, thus resulting in helplessness. The different levels to which the hypothesis refers should be considered critically. For negative tears, helplessness is attributed to the triggering event (e.g., death of a relative); for positive tears, helplessness is attributed to the emotional reaction (e.g., feeling overwhelmed by joy). In this respect, the helplessness hypothesis is not stringent. In summary, for negative tears, the helplessness hypothesis is valid, but for tears of joy, it seems far-fetched. This raises the question of what is an appropriate framework when it comes to classifying triggers of emotional crying.

The following part of the chapter corresponds to the article *Five Reasons to Cry – FRC – A Taxonomy for Common Antecedents of Emotional Crying* which was published in *Motivation and Emotion* (Barthelmäs et al., 2022).

4.1. Theory

It is notable that human beings, but likely no other creatures, have a capacity to shed emotional tears (Vingerhoets et al., 2000). This exciting phenomenon has attracted attention not

only in the early days of psychological research (Breuer & Freud, 1895/1957) but also in recent years (for a current review, see Bylsma et al., 2021). Specifically, understanding and categorizing the antecedents of emotional crying has been a central research topic (Vingerhoets et al., 2001). The present work aims to provide a theoretically derived taxonomy to categorize the most common antecedents of emotional crying reflecting the reasons why people are crying.

Prior work relied on data-driven approaches to establish crying taxonomies (see Table 2 for an overview). Researchers conducting prior studies building the basis for our current work either assigned participants' open response reports of their last crying episode into ad hoc categories, or they used exploratory factor analysis to identify clusters among statements describing hypothetical circumstances in which people cry. As shown in Table 2, research using factor analytical approaches resulted in two to four crying factors, whereas most open-response approaches resulted in more categories. The question arises: How many categories are needed to capture the most common triggers of emotional crying? Is it two, eight, any number in between, or even more?

From our point of view, this question cannot be answered based on any prior studies due to four shortcomings. First, most factor analytical approaches relied on the Adult Crying Inventory (ACI; Becht & Vingerhoets, 2002), which contains several items that do not include a description of a *stimulus* (e.g., "I cry when I feel sad"). If a person says, s/he cried because s/he was sad, it remains unclear whether the person was sad because s/he remembered the death of her/is grandmother, or because s/he had an argument with a friend, or because s/he was worrying about the future. Since the mere description of an emotion does not reveal the antecedent of crying, work that used the ACI is limited in this respect. Second, crying proneness scales contain rather uncommon triggers of crying, like "a group that's working harmoniously" (Denckla et al., 2014). Accordingly, these approaches contain only limited ecological validity and can hardly reveal why people *typically* cry. Third, open-response approaches hardly offered

theoretical explanations for their proposed categories. Moreover, work using this approach did not examine interrater reliabilities, which makes it difficult to evaluate the proposed taxonomies. Fourth, a multivariate perspective is mostly missing in prior work. That is, no data is available to evaluate the construct or the criterion validity of the proposed taxonomies (for an exception, see Denckla et al., 2014). In line with these considerations, Bylsma et al. (2021, p. 144) stated that "[…] more psychometric research is needed to characterize better a typology of crying both in the clinical context and in the natural environment".

Given that most (if not all) prior taxonomies were developed applying *data-driven* approaches, we aim to contribute to a better understanding of emotional crying by developing a *theory-driven* taxonomy. In what follows, we first define emotional crying, then outline our theory-driven approach to categorize crying, and finally present empirical evidence for our assumptions.

Definition of emotional crying. Tears can be categorized into basal, reflex, and psycho-emotional tears (Murube, 2009). The present work is devoted to the latter phenomenon which we will refer to as (emotional) crying. Besides the shedding of tears, crying is often accompanied by vocalizations, sobbing, and certain facial expressions. As the term itself implies, emotional crying can be understood as one form of emotional expression (Vingerhoets et al., 2000).

Table 2. *Chronological overview of existing crying taxonomies.*

Authors	Year	Approach	Proposed taxonomy
Millings et al.	2016	[a] explorative and confirmatory factor analyses on basis of participants' ACI ratings	(1) threat to self, (2) joy, and (3) sadness
Denckla et al.	2014	[a] explorative and confirmatory factor analyses on basis of participants' crying proneness scale ratings	(1) attachment tears, (2) societal tears, (3) sentimental/moral tears, and (4) compassionate tears.
Laan et al.	2012	[a] separation of ACI-items into two categories (no theoretical explanation provided)	(1) positive antecedents and (2) negative antecedents
Bylsma et al.	2011	labels assigned by the authors to categorize open-response reports on crying episodes (labels were not theoretically embedded)	(1) conflict, (2) loss, (3) personal failing, (4) suffering of others, (5) positive experience, (6) physical condition, (7) mental experience, and (8) combination/other
Bylsma et al.	2008	labels assigned by the authors to categorize open-response reports on crying episodes (labels were not theoretically embedded)	(1) conflict, (2) loss, (3) personal inadequacy, (4) witnessing suffering, (5) physical suffering, (6) psychological suffering, and (7) positive events
Scheirs & Sijtsma	2001	[a] exploratory factor analysis on basis of ACI ratings	three-factor solution: (1) distress, (2) joy, and (3) sadness; two-factor solution: (1) negative emotions and (2) positive emotions
Vingerhoets et al.[b]	1997	labels assigned by the authors to categorized open-response reports on crying episodes (labels were not theoretically embedded)	(1) rejection, (2) personal inadequacy (including: 'becoming the cause of other people's suffering' and 'having done something in conflict with your conscience'), (3) physical pain, injury, and psychological pain (e.g., seeing other people suffer, making people disappointed), (4) separation, (5) criticism, being rebuked, and (6) positive factor
Wagner et al.[b]	1997	labels assigned by the authors to categorize open-response reports on crying episodes (labels were not theoretically embedded)	no taxonomy proposed, but the following antecedents were reported: (1) confrontation with death and (2) overtired, frustrated, or been criticized or humiliated by senior staff
Williams & Morris[b]	1996	[a] exploratory factor analysis on basis of 30 antecedents of crying	(1) personal distress: (a) feeling alone or helpless, (b) being criticized or hurt, and (2) tender feelings
Kraemer & Hastrup	1986	labels assigned by the authors to categorize open-response reports on crying episodes (labels were not theoretically embedded)	(1) being moved emotionally, (2) watching a TV program or movie, (3) death of family or friends, and (4) feeling sad or depressed
Frey et al.[b]	1983	labels assigned by the authors to categorize open-response reports on crying episodes (labels were not theoretically embedded)	(1) interpersonal issues, (2) media matters, and (3) sad thoughts
Bindra[b]	1972	labels assigned by the author (labels were not theoretically embedded)	(1) elation—typically associated with situations like reunion, reciprocation of love, or music, (2) dejection—often linked with separation and/or loss, and (3) anguish—frequently associated with conflict, humiliation, or failure

Young[b]	1937	labels assigned by the author to categorize open-response reports on crying episodes (labels were not theoretically embedded)	(1) disappointment or discouragement, (2) lowered self-esteem and a sense of personal inadequacy, (3) unhappy mood, (4) organic state, (5) special events, like death of a loved one […], music or movie or sermon, and (6) laughter to the point of tears
Borgquist[b]	1906	labels assigned by the author to categorize open-response reports on crying episodes (labels were not theoretically embedded)	(1) grief or sadness, (2) anger, and (3) joy

Notes. ACI = Adult Crying Inventory; [a] based on crying proneness ratings; [b] also mentioned in the overview provided by Vingerhoets and colleagues (2001). Please note that we omit unpublished, pre-printed, and non-empirical work in this overview.

We propose that considering theories on emotions can help to better grasp the phenomenon of emotional crying. Applingy an appraisal-theory perspective seems especially promising in this context. Appraisal theories assume that episodes that involve emotions comprise the following components: (a) appraisal, (b) action tendencies, (c) somatic responses, (d) expressive behavior, and (e) emotional experiences or feelings (Moors, 2013). A confrontation with a large pit bull (stimulus) could be decomposed as follows: (a) *My life is in danger*; (b) *preparation for flight*; (c) *increased heartbeat*; (d) *eyes wide open*; and (e) *fear*. This example illustrates two important assumptions. First, the stimulus must be goal-relevant to elicit an emotion. A large pit bull is more likely relevant for the goal of remaining physically unharmed, than a Chihuahua. Second, the appraisal component is assumed to play a causal role when emotions are elicited. The appraisal "I have known the pit bull for ten years, it will not bite me" probably triggers a quite different process than the appraisal "my life is in danger". This consideration is not unique to appraisal theories but is also reflected in other emotion theories. Both, basic emotion approaches (e.g., Ekman, 1972) and social construction approaches (e.g., Harré, 1986) assume that the appraisal component has a causal role in the emergence of emotions. Even though the appraisal component is assumed to initially trigger the emotion episode, this process is by no means strictly linear (a → b → c → e), but all components are assumed to interact in a bidirectional and synchronizing manner (a ↔ b, a ↔ c, …; see Scherer & Moors, 2019, for a current review). As crying is observable by others, it could be subsumed under the behavioral component of the above-described process (see Bylsma et al., 2021, for a similar conceptualization by using the term *crying behavior*).

The appraisal-perspective provides specific guidance regarding which components of an emotion episode are suitable to serve as antecedents of crying. Given that the feeling component (e.g., "I feel sad") is assumed to result from the reflection of the other components (Scherer & Moors, 2019), it seems not qualified for that purpose. We propose that focusing on the stimulus

and its appraisal is most fruitful (see Vingerhoets et al., 2001, for a discussion of this issue). The term appraisal means that a stimulus is evaluated regarding its impact on one's well-being (Scherer & Moors, 2019). Stimuli can be appraised either with regard to satisfaction or frustration of well-being (Frijda, 1986) and this evaluation can take place against different backgrounds. If current goals serve as a frame of reference, the appraisal can vary inter-individually, since current goals can be idiosyncratically very different between persons. If, on the other hand, psychological needs, like the need for relatedness (Deci & Ryan, 2000), serve as a frame of reference, the appraisals of different individuals are more similar, since it is assumed that psychological needs apply to all people (and thus vary less strongly than current goals). Aiming to establish a theory of common antecedents of human emotional crying, we suppose that a psychological need perspective is especially fruitful for our endeavor.

Psychological needs. Crying represents an *emotion expression* and emotions enter the scene when psychological needs are frustrated or satisfied (e.g., Tay & Diener, 2011). If my partner is breaking up with me, this frustrates my need for relatedness, which might be accompanied by tears of sadness. If my wife tells me that she is pregnant (and we have a desire to have children), this might be one of the strongest possible satisfactions of my need for relatedness and might be accompanied by tears of happiness. Apparently, psychological needs seem highly relevant in the context of emotional crying and we will therefore refer to them in order to substantiate our taxonomy. Further, satisfaction of psychological needs has been directly linked to better SWB and the association seems comparable across different cultural backgrounds (e.g., Chen et al., 2015). Different research groups and scholars have dealt with psychological needs (e.g., Baumeister & Leary, 1995; Deci & Ryan, 2000; Grawe, 2004; Young et al., 2006). Even though these approaches differ regarding the specific terms used, there is significant agreement that humans have the following basic needs: *relatedness*, *autonomy*, and *competence* (see Sheldon et al., 2001 for an empirical perspective). Humans "want to feel

effective in their activities (competence), to feel that their activities are self-chosen and self-endorsed (autonomy), and to feel a sense of closeness with some others (relatedness)" (Sheldon et al., 2001, p. 326)[7]. In the context of crying, needs have been mostly neglected. Given their general link to emotions and to subjective well-being (Chen et al., 2015), it seems highly plausible that they are also related to crying. Next, we elaborate on how we developed our taxonomy.

Development of the taxonomy. Our theory-driven approach for the development of a taxonomy containing the *most common* triggers for adult crying consisted of four steps. First, we formulated theoretically plausible crying categories drawing on the frustration/satisfaction of psychological needs. Second, we reduced the complexity of our taxonomy by keeping the categories that were empirically most common. Third, we performed a dry run and tested whether the items of the ACI could be reliably assigned to our taxonomy. Fourth, we conducted a retrospective and a thirty-day long diary study to test our assumptions. The frustration/satisfaction of the above-mentioned needs suggested the following crying categories.

1) Loneliness: This category represents crying due to frustrated relatedness. The following examples came to mind when we thought about tears due to relatedness frustration: (i) dispute with a friend, (ii) separation from family (homesickness), and (iii) being rejected from a relevant group or person (lovesickness). The examples cited here have in common that a desired interpersonal closeness to other people goes unfulfilled. We assume that the valence associated with this category is exclusively negative.

2) Impotence: This category represents crying due to frustrated autonomy. The following examples came to mind when we thought about tears due to autonomy frustration: (i)

[7] It is uncertain whether self-esteem should be considered as a fourth need (Sheldon et al., 2001). In short, self-esteem means that humans want to feel as a "worthy person who is as good as anyone else rather than feeling like a 'loser'" (Sheldon et al., 2001, Appendix B). We assessed self-esteem in Study 3 but found high correlations with competence; thus, we decided not to refer separately to self-esteem when substantiating our taxonomy.

confrontation with the fact that someone is seriously sick or dead, (ii) realization of one's mortality, and (iii) confrontation with helpless others. Each of these examples has a high potential to trigger the insight that humans can control their lives only to a certain extent. We assume that the valence associated with this category is exclusively negative. We assume that confrontation with impotence is most potent to elicit tears when someone we feel close to is involved; accordingly, frustrated relatedness might be relevant in the sense of a subordinate need for this category.

3) Overload: This category represents crying due to frustrated competence. The following examples came to mind when we thought about tears due to competence frustration: (i) stress at work, (ii) self-reproach for personal failure, and (iii) worries about the future. This set of examples has in common a mismatch of situational demands and coping resources. We assume that the valence associated with this category is exclusively negative. Threatened autonomy might be relevant in the sense of subordinate needs for this category since a mismatch of skills and demands has the potential to make limited control salient.

4) Harmony: This category represents crying due to satisfied relatedness. The following examples came to mind when we thought about tears due to relatedness satisfaction: (i) learning about a wanted pregnancy, (ii) bursting into a fit of laughter with important others, and (iii) listening to an inspiring speech. These examples have in common that a desired interpersonal closeness to other people is fulfilled. We assume that the valence associated with this category is exclusively positive.

5) Freedom: This category represents crying due to satisfied autonomy. The following examples came to mind when we thought about tears due to autonomy satisfaction: (i) being released from jail, (ii) the end of an abusive relationship, and (iii) survival of a serious illness. Here, the examples have in common that a desired autonomy is regained. We assume that the

valence associated with this category is predominantly positive. Given that all examples can be associated with a preceding frustration of autonomy, we also expect some negative valence.

6) Success: This category represents crying due to satisfied competence. The following examples came to mind when we thought about tears due to competence satisfaction: (i) finishing one's studies, (ii) winning a competition, and (iii) getting a longed-for job. This set has in common that people feel effective in their activities. We assume that the valence associated with this category is predominantly positive. Since all examples can be associated with a preceding privation, some negative valence might be expected.

These six categories have in common that they *directly* affect the person who is crying. We propose that another category of crying can be theoretically derived from a psychological need perspective, which involves a more *vicarious* way of shedding tears.

7) Media: The consumption of media/art content is part of everyday life for most individuals. It takes place via video-on-demand platforms, social networks, playing computer games, watching TV, going to the movies, reading books, magazines, newspapers, and so on. Vorderer et al. (2006) proposed that enjoyment from media consumption can result from an immediate and transient hedonic experience, e.g., when watching a funny movie, or from a satisfaction of psychological needs, such as relatedness, autonomy and competence (see also Rigby & Ryan, 2016). The latter assumption is well-examined in the context of computer games. Tamborini et al. (2010) demonstrated that satisfaction of the SDT-needs while playing explained about 50% of the variance in enjoyment (for similar results, see Oliver, 2016; Peng et al., 2012 and Ryan et al., 2006). Since watching movies or series is more passive in nature, it was assumed that relatedness is the most dominant need involved in this context (Rigby & Ryan, 2016). In parallel, Oatley (1999) proposed that identification with a protagonist and the possibility to vicariously experience scenarios and emotional reactions, are main motivational forces underlying fiction reading. However, some considerations and findings suggest that passive

forms of media consumption also satisfy other needs than relatedness. First, it can be argued that even though passive, watching a movie or reading a book is a *voluntary* exposure to media content (Rigby & Ryan, 2016). In line, evidence suggests that binge-watching (i.e., the intensive, consecutive use of televised series) can increase perceived autonomy and well-being (Granow et al., 2018)[8]. Second, current empirical evidence demonstrates that watching series is not only associated to relatedness-satisfaction, but to all SDT-needs (Sherrick et al., 2021). Third, one can assume that media content is able to elicit crying when it deals with loneliness, impotence, overload, or harmony. Thus, it seems to represent a hybrid category in which the topics and the underlying needs of all other categories are involved.

In sum, we assume that this category is related to a satisfaction of all SDT-needs, while the strongest associations probably occur for relatedness-satisfaction. The following examples came to mind when we thought about tears due to confrontation with media/ art: (i) watching a sad or funny movie, (ii) watching an inspiring speech on TV, and (iii) empathizing with the protagonist in a book. These examples have in common that the crying individual is mostly *vicariously* affected, by relating to or identifying with the protagonist of the consumed media content. We assume that the valence associated with this category is mixed as individuals can shed tears of sadness and joy in response to movies. We further assume that media/art content is able to elicit crying when it deals with topics of all other categories (e.g., rejection from someone), thus, it represents a hybrid category in this respect. Even though the topics of the other categories can be involved in media-related crying, different need relations are expected. When someone is crying because of being rejected, this should be associated with relatedness-frustration (loneliness). Crying while watching a movie about someone being rejected should be more likely related to relatedness-satisfaction (as theorized in the previous paragraph). This

[8] However, it should not go unmentioned that binge-watching can also exert negative effects on well-being, especially when goal conflict and feelings of guild are involved.

suggests that the media category cannot simply be subsumed under the other categories, but represents an independent reason of crying.

Study overview. We conducted a pilot study (Study 2), a validity check and two empirical studies. In the pilot study, we tested whether we could detect the proposed categories empirically. In the validity check, we tested whether independent raters could use our taxonomy to reliably categorize the items of the ACI. In Study 3, participants reported on their last crying episode and we tested the reliability of our taxonomy, the prevalence of the proposed categories, and the construct and the criterion validity. In Study 4, we conducted an electronic diary study to test our assumptions in an ecologically valid way. For all studies, we report on all measures, data exclusions, and how we determined sample size. Data were analyzed using SPSS (version 26) and R (version 4.1; R Core Team, 2020) with lme4 (version 1.1.27.1; Bates et al., 2015) to perform multilevel modelling. Materials, data, codebooks and codes are available under https://osf.io/ynema/.

4.2. Study 2 – Pilot Study

The study was approved by the local ethics committee. All participants signed an informed consent form and received 1€ (approx. 1$) as compensation.

4.2.1. Materials and Methods

Procedure. The aim of the pilot study was to get a first impression of how frequently the proposed categories occur empirically. For this reason, we asked participants to describe their last crying episode in a few sentences. The study contained additional measures, which are not reported here for the sake of brevity (all measures are described in the supplemental material; Appendix B). The study contained one attention-check item ("please answer 'completely accurate'"). Participants were excluded if they answered it incorrectly.

Analytical strategy. The first author (rater A) assigned participants' crying episodes to one of the above-mentioned categories, to a "residual" or a "vague" category. The vague category

was used when the episode was described too vaguely (e.g., “I cried”). The risidual category was used when a specfic reason was meantioned but did not fall within our taxonomy (e.g., “I broke my ankle”). Items that were assigned to one of the above-mentioned categories were then rated by rater B and rater C. This procedure was held constant for all studies in this article. The ratings for the pilot study (Study 2), validitiy check, Study 3, and Study 4 were performed by the same three raters.

Sample. Our sample comprised 298 participants (M_{age} = 26.12, SD_{age} = 4.57, $range_{age}$ = 18 – 40, 254 women, 44 men, 62.80% students). A study by Horstmann et al. (2020, Study 2) served as template for sample size and sample composition (see supplements; Appendix B). We recruited German-speaking participants from the crowdworking platform clickworker. Data were collected in December 2020.

4.2.2 Results

Interrater-reliability for FRC. Fleiss’ Kappa was almost perfect κ = .90 (cf. Landis & Koch, 1977; see Table S1 for details).

Prevalence of the categories. Most crying episodes were overload-related (26%), followed by media (25%), loneliness (21%), impotence (13%) and harmony (4%). None of the episodes were success- or freedom-related. Three episodes fell into the residual category (1%). The vague category was used for 10% of the episodes.

4.2.3. Discussion

We observed a high interrater reliability when our taxonomy was used to categorize crying episodes. The pilot study revealed empirical evidence for the existence of all categories except success and freedom. Even though extraordinary success, like winning an important athletic competition, can undoubtedly trigger crying, our results suggest that such episodes occur rarely in Jane or John Doe’s everyday life. In parallel, a boost in freedom that is potent enough to trigger tears seem to occur seldomly. With this in mind, we decided to reduce the complexity

of our model to a taxonomy of *common* crying triggers by dropping success and freedom. Hence, we assumed the *five reasons to cry* (FRC) are sufficient to capture the most common crying antecedents. A model that takes all triggers of crying into account would certainly be desirable but is not feasible for at least two reasons. First, a model that refers to *common* crying triggers can be empirically tested more stringently than a model that also considers *rare* crying triggers; that is, frequent triggers can be sampled without requiring participants to recall crying episodes that occurred months or years ago. Second, a limitation to common triggers increases the ecological validity of our model. In a next step, we tested whether independent raters could use our taxonomy to reliably categorize the items of the ACI.

4.3. Validity check

4.3.1. Materials and Methods

Procedure. Three independent raters used the FRC to categorize the items of the ACI. The ACI is "[p]robably the most extensive list […] which contains a total of 55 negative and positive situations and emotions that are more or less likely to elicit tears in several cultures" (Vingerhoets et al., 2001, pp. 80-81). A priori, we excluded seventeen items as they did not contain an appraisable stimulus or were formulated ambiguously (see last row in Table 3).

Measures. The raters were familiar with the conceptualization of the FRC. They assigned the 38 remaining items to one of the FRC or to a residual category.

Analytical strategy. Fleiss' Kappa served as indicator of interrater reliability. The first author performed his rating (rater A). Items that were assigned to one of the FRC were then rated by rater B and rater C.

4.3.2. Results and Discussion

Fleiss' Kappa was 'almost perfect', $\kappa = .87$ (Landis & Koch, 1977; see Table S1 for details). Nine items fell into media, eight into impotence, eight into harmony, seven into loneliness, and two into overload (Table 3). Hence, it was possible to reliably assign most of

the ACI items to one of our proposed categories. In sum, we found first evidence in favor of the FRC.

For an additional evaluation of our taxony's construct validity, we measured *situation characteristics* in our next study. Since we did not introduce the concept so far, we would like to do so at this point. By situation characteristics we refer to an elementary evaluation or interpretation of situations with regard to psychologically relevant features (Rauthmann et al., 2014). In contrast, *situation cues* are conceptualized as physical stimuli that can be objectively qualified (e.g., who is present in the situation?, cf. Rauthmann et al., 2014). The assessment of situation characteristics is especially fruitful for our endeavor as this allows us to capture an elementary evaluation of crying episodes. To better grasp the concept of situation characteristics, an analogy to personality traits can be drawn. Just as personality traits help to describe relevant person characteristics (e.g., "Peter is extraverted"), situation characteristics are used to characterize relevant features of a situation (e.g., "the situation was sexually charged"). According to a framework proposed by Rauthmann and colleagues (2014) eight situation characteristic dimensions – the so-called situational 8 DIAMONDS - can be differentiated: Duty, Intellect, Adversity, Mating, pOsitivity, Negativity, Deception and Sociality. The basic idea underlying the DIAMONDS model is that individuals evaluate situations in a capacity-saving way with regard to underlying qualities that have proven to be relevant (Rauthmann et al., 2014).

Table 3. *Results of the validity check - assignment of ACI items to the FRC*

1) loneliness	2) impotence
… when I say goodbye to loved ones … over loss of love relationship … when involved in quarrels/conflicts … having been humiliated/insulted … when I experience opposition from someone else … when someone criticizes or lectures me … when I feel rejected by others	… at funerals … when a tragic event happens … when I realize my own vulnerability/mortality … when I attend/witness memorial meetings … because of problems of someone else … when I see others suffering … out of pity for others … when I watch other people crying
3) overload	4) harmony

… when things do not go well with work/studies … when I do not succeed in getting things together	… when making love … when someone does something very special for me/someone … at weddings … sometimes I laugh so hard I cry … when practicing religious activities … when I am reuniting with friends/family members … I can be moved to tears by beauty of natural scenes … when I hear national anthem or see national flag rise
5) media … when I hear a happy song … when I hear a sad song … while reading poetry … film/TV happy ending … when reading certain books … in response to beauty of arts … when watching awards ceremony at sporting event … while I watch sad film/TV … when watching/hearing an admired person	residual category … deliberately to make someone feel sorry for me … when I have achieved success … when I experience physical pain … when I am ill [not seriously]
excluded	
stimulus missing: … when I feel frightened … when I feel sad … when I feel angry … when I am in despair … when I feel very happy … when I feel powerless … when feeling self-pity … when I feel relieve … when I feel ashamed … when I feel guilty	too ambiguous: … when things don't go as I want them to … when I am in a blind-alley situation … when talking with therapist/doctor … if I remember sad things that happened to me … happy memories … when I experience painful memories … when I experience disgust or contempt for something/one

4.4. Study 3

4.4.1. Materials and Methods

The study was approved by the local ethics committee. All participants signed an informed consent form and received 1€ (approx. 1$) as compensation.

Procedure. We asked participants to report on their last crying episode and to rate it on several scales. Further, participants themselves assigned their crying episodes to one of the FRC. For exploratory analyses, we asked participants whether another person (or animal) was involved in their crying episode, and we instructed participants to describe and rate one non-crying episode of the previous day. Finally, we assessed subjective well-being (SWB).

The study was pre-registered under https://osf.io/w9d38 (see Appendix C). Hypotheses are summarized in Table 4. The study contained two attention-check items (e.g., "please answer 'not accurate at all'"). Participants were excluded from the study if they answered one of these items incorrectly.

Measures and instructions. We instructed participants to mention a stimulus when describing their last crying episode and gave various examples (e.g., "I saw a touching movie"). To prevent priming effects, we gave two examples for each of the FRC. Participants were able to move to the next survey page after 20s had elapsed.

We formulated 15 items to capture the FRC (three items per category, see Table S2). Participants were instructed to choose one of the given reasons that best described their crying episode. Participants could also choose an open-response answer, in case none of our items was applicable.

We used the Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS – daily measures) to assess need satisfaction/frustration for relatedness, autonomy, and competence in the crying episode (Mabbe et al., 2018)[9]. A sample item for autonomy satisfaction read, "I felt a sense of choice and freedom in the things I did". Each need was measured with two frustration and two satisfaction items (1 = "not accurate at all", 8 = "completely accurate").

We used the S8-I, an ultra-brief questionnaire, to assess the situation characteristics of the crying episodes (Rauthmann & Sherman, 2018). According to a framework proposed by Rauthmann and colleagues (2014), eight situation characteristic dimensions. The item for Duty was *work had to be done*; for Intellect, *deep thinking was required*; for Adversity, *someone was threatened, accused, or criticized*; for Mating, *potential sexual or romantic partners were*

[9] We used four items from Thewissen et al. (2008) to measure self-esteem satisfaction/frustration.

present, for pOsitivity, *the situation was pleasant*; for Negativity, *the situation contained negative feelings (e.g., stress, anxiety, guilt, etc.)*; for Deception, *someone was deceived*; and for Sociality, *social interaction was possible or required*. Responses were given on an 8-point rating scale (1 = “not accurate at all”, 8 = “completely accurate”). The scale was applied to get additional information regarding the construct validity of the FRC.

Table 4. *Overview of preregistered hypotheses, research questions, and exploratory analyses*

Hypotheses	
1)	Do the categories differ with respect to psychological needs? In contrast to media ...
1a)	...loneliness is characterized by higher relatedness-frustration (lower relatedness-satisfaction)
1b)	...impotence is characterized by higher autonomy-frustration (lower autonomy-satisfaction) and higher relatedness-frustration (lower relatedness-satisfaction)
1c)	...overload is characterized by higher competence-frustration (lower competence-satisfaction) and higher autonomy-frustration (lower autonomy-satisfaction)
1d)	...harmony is characterized by higher relatedness-satisfaction (lower relatedness-frustration)
2)	Do the categories differ with respect to situation characteristics? In contrast to media ...
2a)	...loneliness is characterized by higher adversity, mating, negativity, sociality, and lower positivity
2b)	...impotence is characterized by lower positivity as well as higher negativity and sociality
2c)	...overload is characterized by higher duty and negativity as well as lower positivity
2d)	...harmony is characterized by higher mating, positivity, and sociality
3)	Do the categories differ with respect to emotion intensity? In contrast to media ...
3a)	...loneliness is characterized by lower happiness and higher sadness
3b)	...impotence is characterized by lower happiness and higher sadness
3c)	...overload is characterized by lower happiness and higher sadness
3d)	...harmony is characterized by higher happiness and lower sadness
4)	Do the categories differ with respect to crying characteristics (i.e., duration and intensity of crying)?
4a)	crying duration is longer for loneliness, impotence, and overload compared to media (no difference between harmony and media)
4b)	crying is more intense for loneliness, impotence, and overload compared to media (no difference between harmony and media)
5)	Do the categories differ with respect to their relation to subjective well-being?
5a)	the categories differ with respect to their relation with subjective well-being
5b)	subjective well-being is higher for individuals who report a harmony-related crying episode compared to individuals who report a media-related crying episode (within the past four weeks)

5c)	subjective well-being is higher for individuals who report a media-related crying episode compared to individuals who report a loneliness-, impotence- and overload-related crying episode (within the past four weeks)
6)	Do crying- and non-crying-episodes differ with respect to situation characteristics?
6a)	crying-episodes are characterized by lower duty and positivity as well as higher intellect, adversity, mating, and negativity
Research Questions (no hypotheses)	
7)	Can raters reliably assign participants' crying-reports' to the proposed categories?
8)	Can participants assign their crying-episode to one of our proposed categories, and does our rating match participants' ratings?
Further analyses	
	Are there further emotion-differences between the crying-categories?
	Are there further emotion- and need-differences between non-crying- and crying-episodes?
	How often is the "other-category" used when participants use the "Five-Reasons-to-Cry inventory"?

Note. As we found high correlations between self-esteem and competence empirically, we decided not to refer to self-esteem when substantiating our taxonomy (see also Footnote 1). Accordingly, hypotheses related to self-esteem are not depicted in this table. Please note that alternative labels were used for three of the crying categories in the pre-registration (conflict instead of loneliness, death instead of impotence, and stress instead of overload).

Participants reported how long they had cried (in minutes) and how intensely (1 = "little intense", 7 = "very intense"; Becht & Vingerhoets, 2002).

We used the intensity subscale from the Multidimensional Emotion Questionnaire (MEQ) to assess emotion intensity in the crying episode (Klonsky et al., 2019). The scale measures ten emotions, each with one item—namely, happy, inspired, enthusiastic, proud, excited, sad, afraid, anxious, ashamed, and angry (1 = "very weak", 8 = "very strong").

The WHO-5 well-being index (WHO-5) from Topp et al. (2015) was used to assess the affective/eudaimonic component of SWB with 5 items. If participants reported a crying episode within the past four weeks, they were instructed to rate the WHO-5 for the period since crying (ω = .92). Respondents whose crying episode was more than one month ago were instructed to relate the WHO-5 items to the last two weeks (ω = .92). A sample item reads "I have felt cheerful in good spirits" (1 = "at no time", 8 = "all of the time").

Analytical strategy. First, we calculated Fleiss' Kappa. Second, we examined the prevalence of the categories with relative frequencies. Third, we tested the construct validity of our taxonomy by conducting the following analyses: We computed a multinomial logistic regression (MLR) predicting the FRC by need frustration/satisfaction. MLR is an extension of binary logistic regression used when the dependent variable consists of more than two unordered categories. One category is set as a baseline category, and the coefficients are the expected change in the logit for each unit change in the predictor. Further, we computed MLRs predicting the FRC by the 8 DIAMONDS and by emotion intensity. In addition, we used univariate ANOVAs to test whether the FRC differed with respect to crying characteristics. Fourth, we tested criterion validity conducting a univariate ANOVA to test whether the FRC differed with respect to SWB.

Sample. We used G*Power to determine the sample size (Faul et al., 2009). We conducted the power analysis for a test with structural similarities to multinomial regressions. We

determined sample size for a MANOVA with five groups (i.e., FRC), 8 response variables (i.e., 8 DIAMONDS), a power of $(1 - \beta) = .95$, $\alpha = .001$, and $f^2 = .02$ (small effect). This resulted in a required sample size of $n = 720$. Our sample comprised $N = 720$ participants ($M_{age} = 39.31$, $SD_{age} = 12.63$, $range_{age} = 18 - 85$[10], 301 women, 418 men, 1 non-binary, 13% students). We recruited German-speaking participants from the crowdworking platform clickworker. Data were collected in February/March 2021.

4.3.2. Results

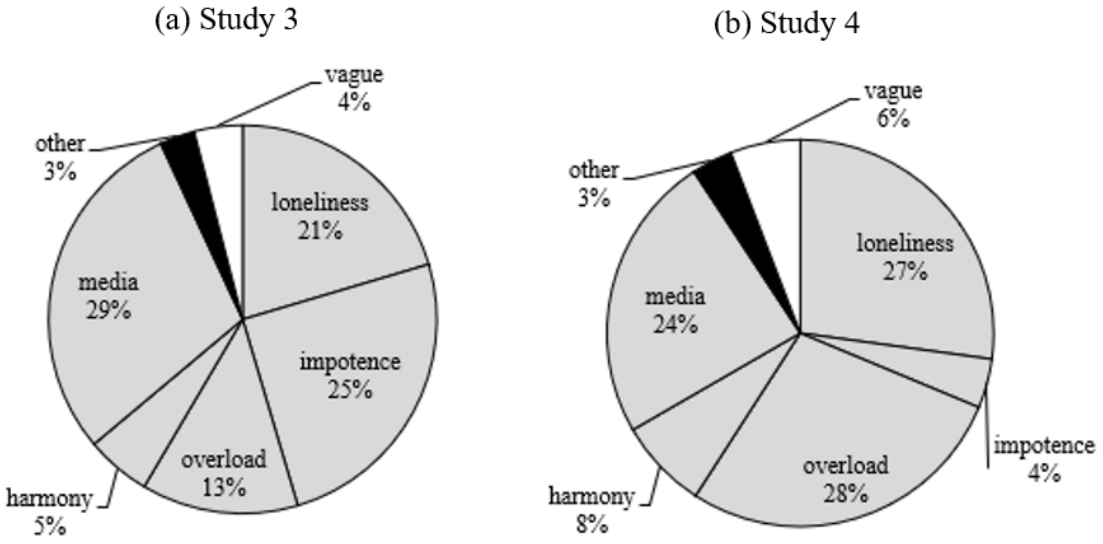

Figure 5. Prevalence of the FRC for (a) Study 3 and (b) Study 4 (Barthelmäs et al., 2022).

Prevalence and reliability. Most crying episodes were media-related, followed by impotence, loneliness, overload, and harmony (Figure 5a). The residual (other) category was small. Only 4% of the episodes could not be assigned due to inaccurate description (vague). Fleiss' Kappa was 'almost perfect', $\kappa = .87$. Participants categorized their crying episode using one of our 15 items in 93.7% of all cases. Only in 6.3% of the cases was the open response option chosen. The interrater reliability between participants' ratings and the ratings of the three independent raters was substantial, $\kappa = .78$.

[10] Two participants did not indicate their age.

Differences in psychological needs for FRC. Five of the six need measures significantly predicted the FRC (Figure 6, Table 5, and Table 6; alpha-level $\alpha = .001$[11]). We did not find a significant effect for competence-satisfaction. We chose media as the reference category because it represents the broadest category thematically, i.e., media can be considered as a hybrid category in which the topics of the other categories can occur. Media was characterized by medium satisfaction and low frustration of all needs. Descriptively, a parallel but more pronounced pattern was observed for harmony. The main findings were that (i) loneliness was associated with relatedness-frustration; (ii) impotence was associated with autonomy-frustration; (iii) overload was associated with competence-frustration, and (iv) harmony was associated with relatedness-satisfaction. A detailed discussion of all findings is provided in the discussion section.

We tested whether a focus on three needs was sufficient by assessing self-esteem as an additional need. Since correlations between self-esteem- and competence-satisfaction ($r = .76$) as well as between self-esteem- and competence-frustration ($r = .75$) were very high, we concluded that considering relatedness, autonomy, and competence was sufficient.

Table 5. Likelihood ratio tests for the multinomial regression predicting FRC by needs

	-2 Log Likelihood of Reduced Model	χ^2	*df*	*p*
competence frustration	1545.36	56.98	4	<.001
competence satisfaction	1495.89	7.51	4	.111
autonomy frustration	1520.10	31.72	4	<.001
autonomy satisfaction	1516.27	27.90	4	<.001
relatedness frustration	1584.40	96.02	4	<.001
relatedness satisfaction	1550.10	61.72	4	<.001
intercept	1542.82	54.45	4	<.001

Notes. Model fit information: $\chi^2(24) = 428.05$, $p < .001$; Negelkerke's $R^2 = 50$.

[11] α-level was set to $\alpha = .001$ to adjust for multiple testing; see also power analysis and pre-registration. Note that we referred to confidence intervals when interpreting the regression coefficients.

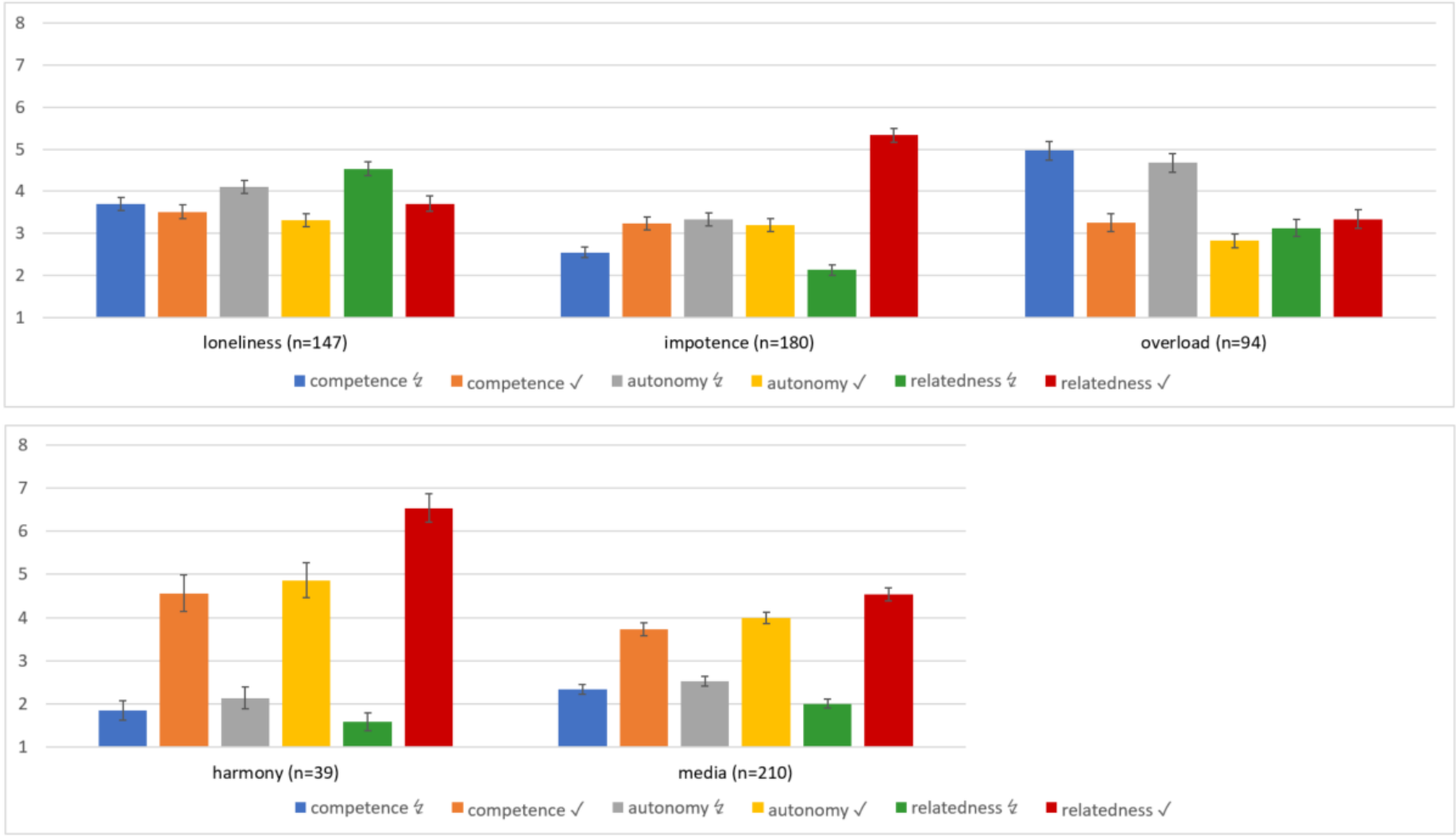

Figure 6. Mean need frustration/satisfaction scores for FRC. ↯ = frustration of psychological need; ✓ = satisfaction of psychological need. Error-bars denote +/- 1 SE (Barthelmäs et al., 2022).

Table 6. *Parameter estimates for the multinomial regression predicting FRC by needs*

	B	*SE*	*Wald*	*df*	*p*	*exp(B)*	*95% CI for exp(B)*	
							Lower Bound	*Upper Bound*
loneliness								
competence frustration	-0.03	0.09	0.11	1	.740	0.97	0.82	1.15
competence satisfaction	-0.06	0.09	0.54	1	.462	0.94	0.79	1.11
autonomy frustration	0.27	0.08	10.48	1	.001	1.31	1.11	1.55
autonomy satisfaction	-0.19	0.09	4.27	1	.039	0.82	0.69	0.99
relatedness frustration	0.57	0.08	48.68	1	<.001	1.77	1.51	2.08
relatedness satisfaction	-0.09	0.07	1.80	1	.180	0.91	0.80	1.04
intercept	-1.65	0.37	19.86	1	<.001			
impotence								
competence frustration	-0.03	0.08	0.15	1	.700	0.97	0.83	1.14
competence satisfaction	-0.08	0.07	1.25	1	.263	0.92	0.81	1.06
autonomy frustration	0.29	0.07	15.94	1	<.001	1.34	1.16	1.54
autonomy satisfaction	-0.30	0.08	15.43	1	<.001	0.74	0.64	0.86
relatedness frustration	0.02	0.08	0.06	1	.802	1.02	0.87	1.20
relatedness satisfaction	0.25	0.05	21.10	1	<.001	1.28	1.15	1.42
intercept	-0.84	0.33	6.39	1	.011			
overload								
competence frustration	0.53	0.09	32.33	1	<.001	1.69	1.41	2.03
competence satisfaction	0.19	0.11	3.06	1	.080	1.21	0.98	1.49
autonomy frustration	0.40	0.09	18.25	1	<.001	1.49	1.24	1.78
autonomy satisfaction	-0.49	0.12	16.21	1	<.001	0.61	0.48	0.78
relatedness frustration	-0.04	0.09	0.15	1	.695	0.96	0.80	1.16
relatedness satisfaction	-0.19	0.08	5.38	1	.020	0.83	0.71	0.97

Table 6 (continued)

							95% CI for exp(B)	
	B	*SE*	*Wald*	*df*	*p*	*exp(B)*	*Lower Bound*	*Upper Bound*
intercept	-2.28	0.47	23.12	1	<.001			
harmony								
competence frustration	-0.10	0.16	0.40	1	.526	0.90	0.65	1.24
competence satisfaction	0.02	0.11	0.02	1	.882	1.02	0.83	1.25
autonomy frustration	-0.12	0.13	0.85	1	.356	0.88	0.68	1.15
autonomy satisfaction	0.01	0.12	0.02	1	.902	1.01	0.81	1.28
relatedness frustration	-0.03	0.17	0.03	1	.872	0.97	0.69	1.37
relatedness satisfaction	0.39	0.10	14.73	1	<.001	1.48	1.21	1.82
intercept	-3.47	0.74	21.77	1	<.001			

Notes. SE = standard error; *CI* = Confidence Interval.

Differences in 8 DIAMONDS for FRC. Five of the 8 DIAMONDS significantly predicted the FRC, while intellect, adversity, and deception were not significant predictors (Figure 7, Table 7, and Table 8). Media served as the reference category and was characterized by low duty, adversity, mating, and deception, as well as by medium intellect, positivity, and negativity. The main findings were that (i) loneliness was associated with low positivity as well as high sociality, mating, and negativity; (ii) impotence was characterized by high sociality as well as low mating and positivity; (iii) overload was related to high duty and negativity as well as to low positivity; and (iv) harmony was associated with high positivity and sociality.

Table 7. *Likelihood ratio tests for the multinomial regression predicting FRC by 8 DIAMONDS*

	-2 Log Likelihood of Reduced Model	χ^2	*df*	*p*
duty	1379.07	84.87	4	<.001
intellect	1306.137	11.93	4	.018
adversity	1312.40	18.20	4	.001
mating	1331.95	37.75	4	<.001
positivity	1452.03	157.83	4	<.001
negativity	1349.25	55.05	4	<.001
deception	1305.20	11.01	4	.027
sociality	1324.73	30.53	4	<.001
intercept	1438.22	144.02	4	<.001

Notes. Model fit information: $\chi^2(32) = 578.20$. $p < .001$; Negelkerke's $R^2 = .61$.

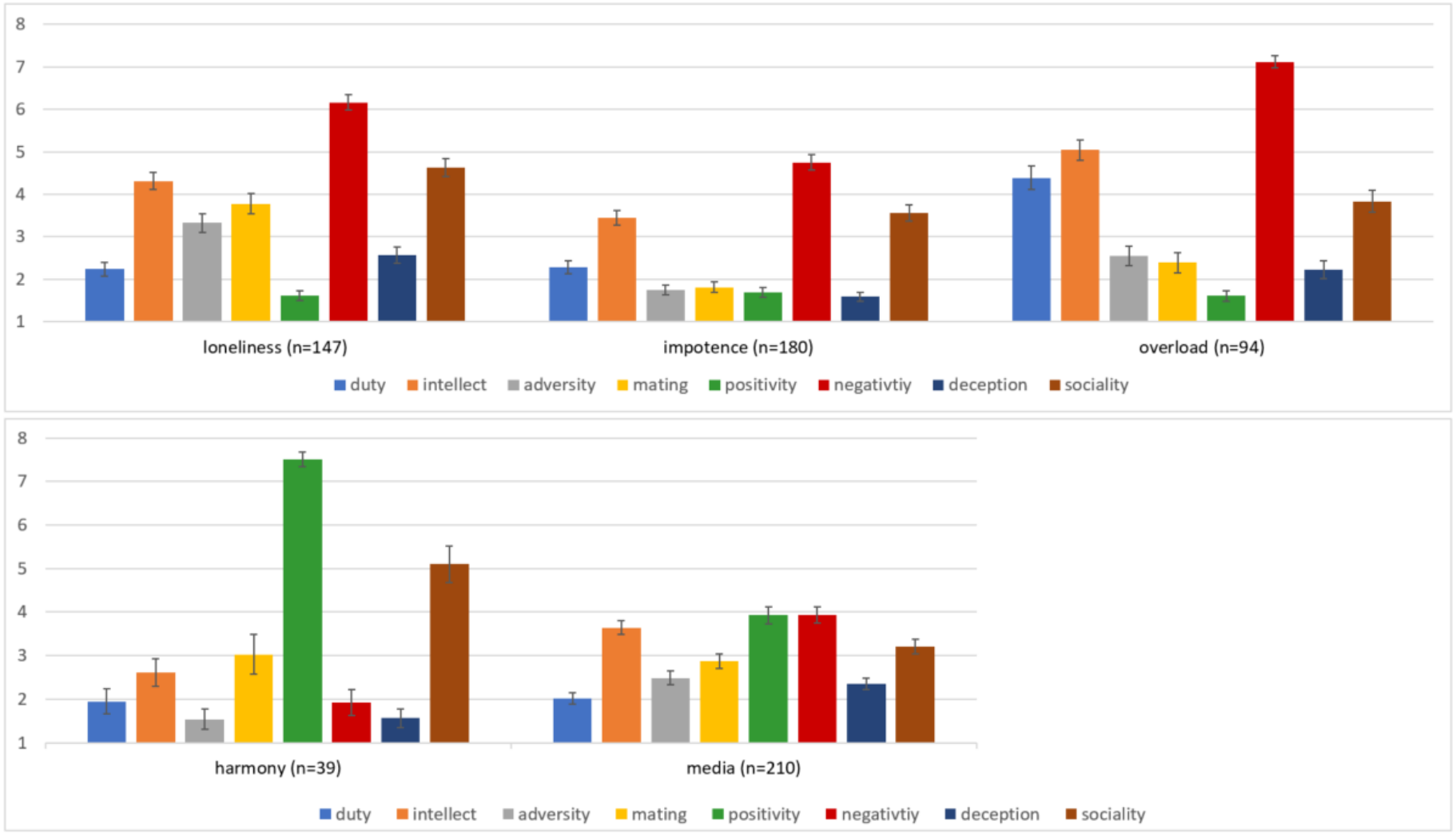

Figure 7. Mean 8 DIAMONDS scores for FRC. Error-bars denote +/- 1 SE (Barthelmäs et al., 2022).

Table 8. *Parameter estimates for the multinomial regression predicting FRC by 8 DIAMONDS.*

	B	*SE*	*Wald*	*df*	*p*	*exp(B)*	*95% CI for exp(B)*	
							Lower Bound	*Upper Bound*
loneliness								
duty	0.12	0.08	2.31	1	.128	1.13	0.97	1.33
intellect	0.01	0.06	0.02	1	.883	1.01	0.90	1.13
adversity	-0.00	0.07	0.00	1	.987	1.00	0.88	1.14
mating	0.17	0.06	10.09	1	.001	1.19	1.07	1.32
positivity	-0.54	0.09	37.85	1	<.001	0.59	0.49	0.69
negativity	0.16	0.06	6.63	1	.010	1.17	1.04	1.32
deception	-0.09	0.07	1.60	1	.207	0.91	0.79	1.05
sociality	0.18	0.06	9.31	1	.002	1.20	1.07	1.34
intercept	-1.18	0.43	7.41	1	.006			
impotence								
duty	0.36	0.08	21.67	1	<.001	1.43	1.23	1.67
intellect	-0.03	0.06	0.36	1	.551	0.97	0.87	1.08
adversity	-0.24	0.08	9.78	1	.002	0.79	0.68	0.92
mating	-0.16	0.07	6.18	1	.013	0.86	0.76	0.97
positivity	-0.47	0.07	48.05	1	<.001	0.63	0.55	0.71
negativity	-0.01	0.05	0.07	1	.791	0.99	0.89	1.09
deception	-0.24	0.09	7.69	1	.006	0.79	0.67	0.93
sociality	0.16	0.06	8.68	1	.003	1.18	1.06	1.31
intercept	1.28	0.36	12.74	1	<.001			
overload								
duty	0.62	0.08	54.19	1	<.001	1.86	1.58	2.19

Table 8 (continued)

							95% CI for exp(B)	
	B	*SE*	*Wald*	*df*	*p*	*exp(B)*	*Lower Bound*	*Upper Bound*
intellect	0.18	0.07	6.27	1	.012	1.20	1.04	1.38
adversity	-0.22	0.09	6.32	1	.012	0.81	0.68	0.95
mating	-0.04	0.07	0.33	1	.564	0.96	0.83	1.11
positivity	-0.38	0.11	11.23	1	.001	0.68	0.55	0.85
negativity	0.57	0.10	31.13	1	<.001	1.77	1.45	2.16
deception	-0.24	0.09	6.84	1	.009	0.79	0.66	0.94
sociality	0.01	0.07	0.02	1	.896	1.01	0.88	1.16
intercept	-4.60	0.79	33.83	1	<.001			
harmony								
duty	0.09	0.14	0.41	1	.524	1.09	0.83	1.45
intellect	-0.13	0.12	1.19	1	.275	0.88	0.70	1.11
adversity	-0.12	0.19	0.39	1	.532	0.89	0.62	1.29
mating	-0.07	0.09	0.66	1	.416	0.93	0.78	1.11
positivity	0.71	0.19	14.61	1	<.001	2.04	1.41	2.93
negativity	-0.07	0.15	0.18	1	.668	0.94	0.69	1.26
deception	-0.02	0.20	0.01	1	.935	0.98	0.67	1.45
sociality	0.33	0.09	14.63	1	<.001	1.39	1.17	1.65
intercept	-6.58	1.53	18.42	1	<.001			

Notes. SE = standard error; *CI* = Confidence Interval.

Differences in emotion intensity for FRC. Examining the relations between the predictors revealed high correlations between sad-happy (r = -.68), sad-enthusiastic (r = -.67), enthusiastic-happy (r = .84), and enthusiastic-inspired (r = .70), and happy-inspired (r = .65). To circumvent problems related to multicollinearity, we omitted sad, enthusiastic, and inspired as predictors.

Three of the seven remaining emotions significantly predicted the FRC. Ashamed was close to significance, while the effects for afraid, excited, and proud were not significant (see Table S3 and Table S4). Media served as the reference category and was characterized by low-to-medium intensity of all emotions, but with a medium intensity of sadness. The main findings were that (i) loneliness was associated with low happiness as well high anger and anxiety; (ii) impotence was characterized by high anxiety as well as low happiness and shame; (iii) overload was related to low happiness as well as to high anger and anxiety; and (iv) harmony was associated with high happiness.

Differences in crying characteristics for FRC. Crying duration significantly differed between the FRC, $F(4,665) = 10.51$. $p < .001$. $\eta_p^2 = .06$. A planned contrast revealed that crying duration was longer in loneliness, impotence, and overload compared to harmony and media, $t(665) = 4.91$, $p < .001$, $r = 0.19$, $|MD| = 9.66$, 95% CI [5.79; 13.53] (Figure 8a). Crying intensity significantly differed between the FRC, $F(4, 665) = 18.61$. $p < .001$. $\eta_p^2 = .10$. A planned contrast revealed that crying intensity was higher in loneliness, impotence, and overload compared to harmony and media, $t(665) = 6.53$, $p < .001$, $r = 0.25$, $|MD| = 1.06$, 95% CI [0.74; 1.38] (Figure 8b).

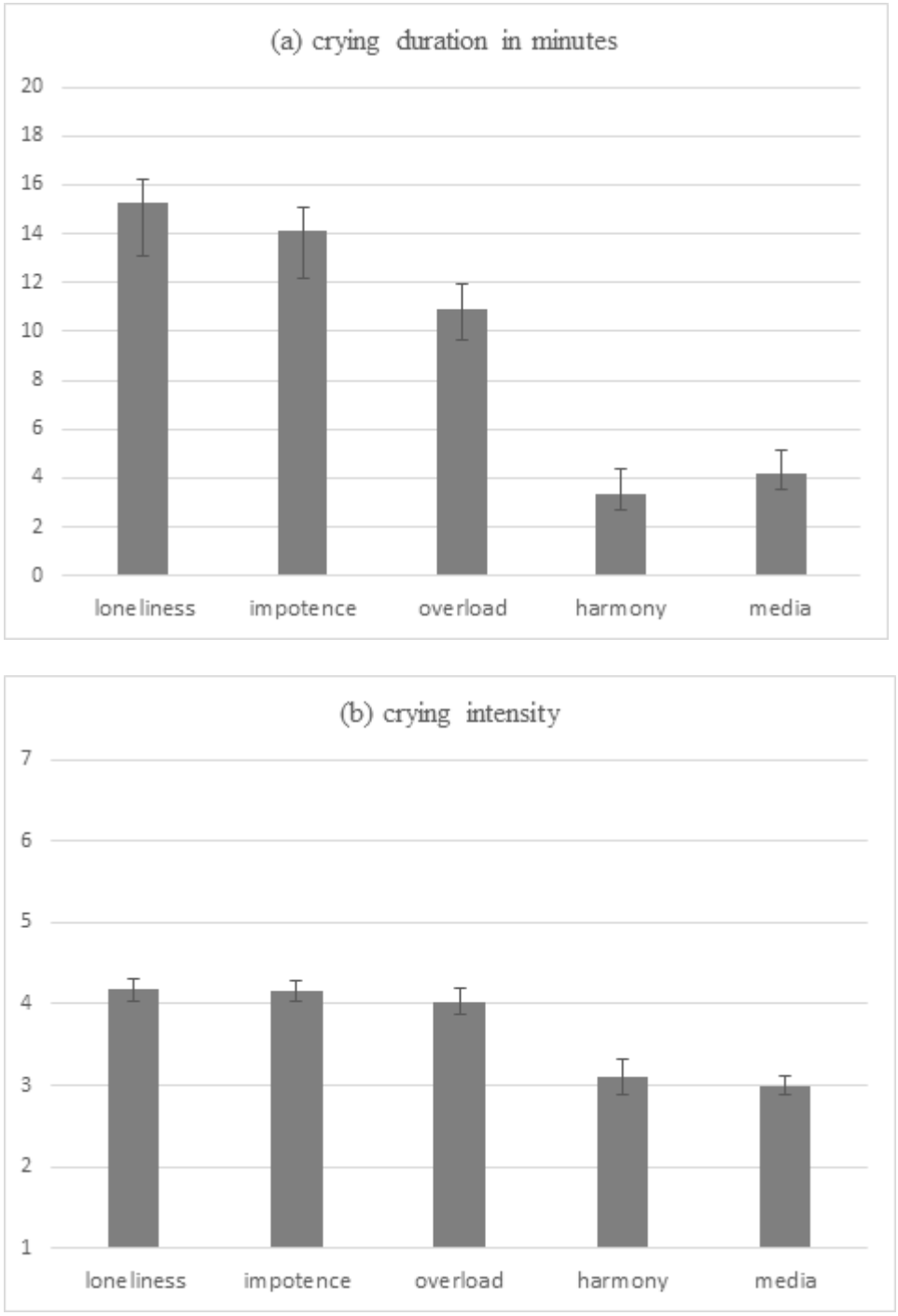

Figure 8. Mean scores of the crying characteristics for the FRC. Higher scores indicate (a) longer crying and (b) more intense crying. Error-bars denote +/- 1 SE (Barthelmäs et al., 2022).

Differences in SWB for FRC. Subjective well-being significantly differed between FRC, $F(4, 493) = 13.63$, $p < .001$, $\eta_p^2 = .10$ (Table 9). A planned contrast revealed that SWB was lower in loneliness, impotence, and overload compared to media, $t(493) = 4.33$, $p < .001$, $r = .19$, |MD|

= 0.66, 95% CI [0.36; 0.96]. A second contrast revealed that SWB was higher for harmony than for media, $t(493) = 4.10$, $p < 001$, $r = .18$, $|MD| = 1.16$, 95% CI [0.61; 1.72].

Table 9. *Descriptive statistics for subjective well-being depending on the antecedent of crying.*

	M	*SE*	*n*
loneliness	4.07	0.14	111
impotence	3.96	0.17	106
overload	3.71	0.17	76
harmony	5.74	0.28	37
media	4.57	0.12	168

Note. As pre-registered, only participants who cried within the past four weeks were considered for this analysis (total n = 498).

Additional analyses. To maintain brevity of this article, we present additional evidence in the supplemental material (Appendix B). This comprises (i) a language analysis of the FRC, (ii) analysis of whether another creature was involved in the crying episodes, and (iii) whether and how crying and non-crying episodes differed.

4.4.3. Discussion

Is our taxonomy sufficiently comprehensive and reliable? We found that participants mostly relied on our categories to assign their crying episodes. Only in 6.3% of the cases was the open-response option used. The interrater reliability between participants' ratings and the ratings of the three raters was substantial. This suggests that our taxonomy covers the most common antecedents of crying and legitimizes the decision to drop "success" and "freedom" for the sake of parsimony and ecological validity.

Is our taxonomy construct-valid? One crucial aspect of the study was to test the relations between the FRC and psychological needs. We found evidence in favor of our theoretical considerations. Focusing on the most dominant effects within each category (i.e., highest odds ratios), we found the following relations. Contrasted against media, loneliness was characterized by higher relatedness-frustration. Impotence was related to higher autonomy-frustration. Overload was associated with a higher competence-frustration. Harmony was characterized by

higher relatedness-satisfaction (all effects consistent with pre-registration). We will discuss the detailed results for each category in the following paragraphs.

Loneliness was additionally characterized by higher autonomy-frustration and by lower autonomy-satisfaction (inconsistent with pre-registration). Although not expected, a lack of influence seems plausible for that category. While we did not find significantly lower relatedness-satisfaction in loneliness (inconsistent with pre-registration), we found the expected pattern on a descriptive level.

Impotence was further characterized by lower autonomy-satisfaction (consistent with pre-registration). We found neither higher relatedness-frustration nor lower relatedness-satisfaction (inconsistent with pre-registration). In contrast, impotence was associated with *higher* relatedness-satisfaction. One explanation could be that impotence is associated with frustrated relatedness in the short term, but not in the long term. The death of a friend might initially frustrate relatedness, but social rituals, such as condolence visits and funeral services, may outweigh this initial frustration.

Overload was additionally associated with higher autonomy frustration and lower autonomy satisfaction (consistent with pre-registration). While we found the expected effect for lower competence satisfaction only on a descriptive level, we unexpectedly found lower relatedness satisfaction (inconsistent with pre-registration). Furthermore, harmony was related to lower relatedness-frustration only on a descriptive level (inconsistent with pre-registration).

When summing up the relations of the FRC to psychological needs, we admit that the results do not support all our predictions. Most strikingly, we found *higher* relatedness-satisfaction in impotence; however, we think it is important to consider the following deliberations. First, regarding the most dominant effects within each category, we found that loneliness was characterized by higher relatedness-frustration, impotence by higher autonomy-frustration, overload by higher competence-frustration and harmony by higher relatedness-

satisfaction (all effects consistent with pre-registration). Second, even though we observed some results that we did not predict and in turn did not observe some of the predicted results, these findings do not debunk our theorizing in general. Of course, some aspects of our model do need to be revised.

The results for the 8 DIAMONDS revealed further evidence in favor of our crying categories: Loneliness was characterized by higher mating, negativity and sociality, and lower positivity (consistent with pre-registration). Adversity did not predict loneliness (inconsistent with pre-registration), but the assumed pattern could be observed descriptively. We found lower positivity and higher sociality for impotence (consistent with pre-registration), but we did not observe significantly higher negativity (inconsistent with pre-registration). At least on a descriptive level, negativity was higher in impotence compared to media, and the analysis further suggested that impotence was characterized by lower mating and higher duty (inconsistent with pre-registration). Lower mating does not conflict with our conceptualization of the category, however, the duty-effect is puzzling and needs further commentary. Looking at the mean scores, it becomes apparent that duty was actually a bit higher in impotence compared to media. Given the small standard-errors, this difference was statistically significant. Practically, the duty-effect seems negligible. For overload, duty and negativity were higher than for media, while positivity was lower (consistent with pre-registration). Harmony was characterized by higher positivity and sociality (consistent with pre-registration); however, we did not find the proposed effect for higher mating. This suggests that harmony-related crying more often involves friends or family members than romantic partners.

We found that crying duration and intensity were longer/higher for loneliness, impotence, and overload compared to harmony and media (consistent with pre-registration). The following explanations might be feasible in this context. First, emotional states might be much easier to regulate when triggered by media. One could, for example, tell oneself that it

was “just a movie”. Second, longer and more intense crying in the three aversive categories might be explained by the principal “bad is stronger than good” (Baumeister et al., 2001). Assuming that negative events and information have a stronger influence on people than do positive ones might explain the observed difference between harmony and the three aversive categories.

We also examined the FRC with regard to emotion intensity. We found lower happiness in loneliness, impotence, and overload compared to media and higher happiness in harmony (consistent with pre-registration). Given the restrictions due to multicollinearity, we could not test the predicted effects for sadness. On a descriptive level, the expected pattern emerged. We observed interesting exploratory findings. Loneliness was characterized by higher anger and anxiousness, impotence was related to lower shame and higher anxiousness, and overload was characterized by higher anger and anxiousness. In sum, the observed effects for emotion intensity seem reasonable and provide further evidence for the soundness of the FRC.

Does our taxonomy possess criterion validity? While prior research could not reveal a clear picture concerning the relation between crying and SWB (summarized in Barthelmäs & Keller, 2021), the present findings demonstrate that the reason that triggers the crying qualifies that relation. As expected, SWB was lower when crying was related to loneliness, impotence, and overload (compared to media). Furthermore, SWB was higher when crying was harmony-related. This suggests that our taxonomy possesses criterion validity.

Limitations. We provided respondents with forced-choice options to categorize their crying episodes. Allowing for the selection of multiple response options will be a meaningful extension of this line of research and we should be implemented in next generation of research. Further, given that participants provided retrospective recalls of their last crying episodes, our data are at risk to be influenced by recall biases.

4.5. Study 4

We therefore report on findings of an electronic diary study, in which participants reported on their affect and arousal state every evening across thirty consecutive days. If participants reported that they had cried during the day, they were instructed to provide information about that episode. Given the retrospective design of Study 3, we tried in Study 4 to get closer to the actual event of crying.

4.5.1 Materials and Methods

The study was approved by the local ethics committee. All participants signed an informed consent form. As compensation, participants received course credit or had the chance to win one of 20 Amazon vouchers worth 10€ (approx. 10$). This study's design and its analysis were not pre-registered

Procedure. We used the *Telegram-Survey-Bot* to conduct the electronic diary study (Barthelmäs et al. 2021). The software is freely available under https://github.com/Raze97/Telegram-Survey-Bot. Participants used their private smartphone to participate. They were instructed to install the messenger app *Telegram* and to add a study-specific chatbot-account to their contact list. Android and iOS users could participate. The software provided survey links once a day at 18:00. Participants could complete the survey until 12:00 the next day.

Measures. We allowed participants to rate their affective state every evening on the underlying core dimensions, i.e., affect and arousal. Specifically, we applied Self-Assessment Manikins (SAMs), which is a commonly used and validated strategy to assess affect and arousal in an efficient way (Bradley & Lang, 1994).

When they had cried during the day, we instructed participants to rate the episode regarding the 8 DIAMONDS (Rauthmann & Sherman, 2018), emotion intensity (Klonsky et al., 2019), and crying characteristics (Becht & Vingerhoets, 2002). To make participation via

smartphone user-friendly, we used a 5-point Likert scale for all items that could be answered with a rating scale.

Initially, we conducted this study as a pilot for a registered report aiming for a large-scale examination of crying in everyday life; accordingly, the study contained various trait and state measures. To maintain brevity of the current article, we only report on measures related to the FRC (see Table S12 for a complete list of all measures).

Sample. We used the approach described by Rotondi and Donner (2012) to determine sample size regarding interrater reliabilities. We used the following settings: 95% CI, lower limit κ = .70, upper limit κ = .90; α = .05; number of raters = 3, anticipated prevalence = see results of Study 3 (full code is depicted in the supplements; Appendix B). This resulted in a required sample size of n = 74. The final sample comprised of 91 participants (M_{age} = 25.48, SD_{age} = 11.27, $range_{age}$ = 18 – 64, 60 women, 19 men, 2 non-binary; 10 participants did not provide demographic information). The sample comprised German-speaking students and employees, who were recruited via personal contact. Data were collected in December 2020 and January 2021.

4.5.2. Results

Compliance-rate. The compliance rate was 83.74%, as we counted 2286 completed questionnaires ($91 * 30 = 2730$ questionnaires sent out). Participants reported 291 crying episodes during the study period. They needed 4.05 min. (SD = 1.76 min.) to complete a survey on average. Twenty participants did not report a single crying episode, whereas 71 participants reported at least one crying episode.

Prevalence and interrater reliability of FRC. Most crying episodes were overload-related, followed by loneliness, media, harmony, and impotence (Figure 5b). The residual category was small: 6% of the episodes could not be assigned due to inaccurate description (vague). Fleiss' Kappa was almost perfect (κ = .83).

Crying characteristics. As crying episodes were nested within participants, we first estimated unconditional means models: 75.6% of variation in crying duration and 81.5% of the variation in crying intensity are attributable to differences in crying episodes rather than differences between individuals. Including FRC as predictor, the results indicate that participants cried longer when the reason was overload ($b = 5.90$, $p = 0.046$) or loneliness ($b = 10.74$, $p < .001$) compared to media (Table 10). For example, the mean duration of crying for media reasons was 3.83 minutes (i.e., model intercept), while the mean duration of crying for loneliness was 14.57 (i.e., intercept plus coefficient loneliness). The intensity of crying was higher for all reasons compared to media.

Table 10. *Random intercept model predicting crying duration and crying intensity by FRC.*

	Crying duration in minutes			Crying intensity		
Predictors	Estimates	CI	*p*	Estimates	CI	*p*
Intercept	3.83	-0.63 – 8.30	.093	1.67	1.40 – 1.94	<.001
Loneliness	10.74	4.90 – 16.59	<.001	1.07	0.72 – 1.43	<.001
Impotence	5.92	-4.76 – 16.61	.277	1.01	0.35 – 1.67	.003
Overload	5.90	0.11 – 11.69	.046	1.00	0.64 – 1.35	<.001
Harmony	3.20	-5.10 – 11.50	.450	0.56	0.05 – 1.07	.031
Random Effects						
σ^2	252.56			0.99		
τ_{00}	52.71			0.15		
ICC	0.17			0.13		
N	71			71		
Observation	264			264		
Marginal R^2/ Conditional R^2	0.052/ 0.216			0.153/ 0.263		

Notes. **Crying episodes were nested in individuals;** random effects represent variability between individuals; τ_{00} = variance between individuals, σ^2 = variance between crying episodes.

Time-course of affect/arousal depending on crying-reason. As time points were nested within participants, we first estimated unconditional means models, finding that 68% of variation in affect and 69.7% of the variation in arousal are attributable in changes over time rather than differences between individuals. Next, we estimated unconditional growth models testing for linear and polynomial time trends by including time as predictor (Table S13). The intercepts represent the mean in affect and arousal on the day of the crying episode, while higher scores indicate more positive affect/more calmness (e.g., mean affect on the day of the crying episode was 3.67). There was a quadratic effect of time on affect (b = 0.02, p < .001) and arousal (b = -0.04, p < .001). The time coefficients represent the changes in the mean per day (or general per measurement unit). In sum, the results indicate that affect was lower/less positive and arousal higher on a crying day.

Given that individuals cry for different and distinct reasons, in a next step we explored the temporal effects and reasons to cry in combination (Figure S5 and S6). The intercepts in Table S14 represent the mean affect and arousal on the day of crying for media. There were main effects for overload and loneliness. The coefficients represent the changes in mean affect ($b_{Overload}$ = -0.41, p < .001, $b_{Loneliness}$ = -0.34, p < .001) and mean arousal ($b_{Overload}$ = 0.45, p < .001, $b_{Loneliness}$ = 0.44, p < .001) when the crying reason was overload and loneliness, respectively, compared to media. There was a significant interaction between the crying reason and temporal effects, indicating that changes in affect over time were stronger in loneliness or overload compared to media. In other words, the increase in affect (more positive) was larger after a loneliness or overload crying episode compared to a media episode. The results show that affect and arousal decrease over time for overload and loneliness, but there was no temporal effect of media on affect and arousal.

8 DIAMONDS and emotions. Given the modest sample size, we could not calculate meaningful test-statistics when exploring the 8 DIAMONDS and emotion profiles for the FRC.

Even though we can only present descriptive statistics (i.e., means and standard-errors), they show such clear parallels to the retrospective studies that we consider them worth reporting (Figures S7 and S8). In short, duty was highest in overload and low in all other categories. Loneliness seemed to be characterized by high adversity and sociality, impotence by high negativity, and harmony by high positivity. Overall, the three aversive categories were associated with aversive emotions, and harmony seemed characterized by pleasant emotions.

4.5.3. Discussion

Comparing the prevalence of the FRC between Study 3 and Study 4, we observed similar frequencies for loneliness, harmony, and media; however, we found about twice as many overload-related episodes in Study 4 and only 4% (vs. 24%) impotence-related crying episodes. This shift might be traced back to the "older sample" in Study 3. Older age is associated with decreases in neuroticism across life span (Wortman et al., 2012), which explains the lower prevalence for overload-related crying in Study 3. Given that increasing age is a crucial risk factor for disease, this might explain why participants reported more impotence-related crying in Study 3. Alternatively, one might conclude that impotence-related crying is somewhat overestimated in retrospective studies. The prevalence for harmony-related crying was low in both studies and is comparable with prior work (Bylsma et al., 2011; Vingerhoets et al., 1997). This speaks against a systematic underestimation of positive tears in our studies.

In line with the diary study by Bylsma et al. (2011), we found a quadratic effect of time on affect. In comparison to the day before and after crying, affect was worst on the crying day, i.e., affect over time followed a U-shape. We found a comparable pattern for arousal. In comparison to the day before and after crying, arousal was highest on the crying day (i.e., inverted U-shape). Importantly, these effects were qualified by the FRC. We found a U-shape pattern for affect in loneliness and overload. On a descriptive level, impotence was also

characterized by a U-shape of affect, while harmony was characterized by an *inverted U-shape* of affect.

Results for crying characteristics were similar to Study 3 as we found longer crying duration and higher crying intensity for the aversive categories. On a descriptive level, we found first evidence suggesting that 8 DIAMONDS and emotion profiles were similar regardless of whether crying episodes are examined with a diary approach or in a retrospective study. Further, interrater reliability was similar when comparing the retrospective and diary approaches.

Limitations. We did not collect data on need frustration/satisfaction. Even though informative, the analyses focusing on the 8 DIAMONDS and emotion profiles can only be considered as preliminary.

4.6. General Discussion

Since crying is a peculiar human phenomenon, we aimed to contribute to a better understanding of this special form of emotion expression. We provide a theoretically derived taxonomy to categorize the most common antecedents of emotional crying: The Five Reasons to Cry. The provided evidence suggests that our taxonomy covers most crying episodes reported by adult individuals. We found high interrater reliabilities when our taxonomy was used to categorize crying episodes, and we found a substantial overlap between participants' self-ratings and our ratings.

In contrast to most former approaches, we provided multivariate data to evaluate our crying taxonomy. Regarding the 8 DIAMONDS, we found sound relations to the FRC. Loneliness, impotence, and overload were associated with high negativity and low positivity, while harmony was associated with a reversed pattern, and media was characterized by medium positivity and negativity. This pattern aligns with our theoretical assumptions. Overload was associated with increased duty. This finding is especially noteworthy as it separates overload from the two other aversive categories. Differences in crying characteristics (i.e., duration and

intensity) indicate that media and harmony are separable from the three aversive categories. The aversive categories can in turn be differentiated based on their relations to psychological needs. Most strikingly, they showed specific associations to the three needs postulated in self-determination theory (SDT; Deci & Ryan, 2000). Loneliness was associated with relatedness-frustration, overload was related to competence-frustration and impotence was associated with autonomy-frustration. The relations to psychological need satisfaction/frustration suggested a parallel pattern for media and harmony. Both categories were associated with satisfaction of psychological needs, but the pattern was more pronounced for harmony. In sum, these findings suggest that the proposed categories are not only theoretically but also empirically distinguishable.

FRC in a nutshell. Table 11 depicts the empirical relations of the FRC to psychological needs and situation characteristics. Contrary to our hypotheses, impotence was characterized by relatedness-satisfaction and loneliness by autonomy-frustration.

Table 11. *Five Reasons to Cry – empirical relations to psychological needs and 8 DIAMONDS*

1) loneliness	2) impotence	3) overload
needs: ↯ relatedness ↯ autonomy 8 DIAMONDS: ↑ mating ↓ positivity ↑ negativity ↑ sociality	needs: ↯ autonomy ✓ relatedness 8 DIAMONDS ↓ adversity ↓ positivity ↑ negativity ↑ sociality	needs: ↯ competence ↯ autonomy 8 DIAMONDS ↑ duty ↓ positivity ↑ negativity
4) harmony	5) media	other
needs: ✓ relatedness 8 DIAMONDS: ↑ positivity ↓ negativity ↑ sociality	needs: ✓ relatedness 8 DIAMONDS: ↕ positivity ↕ negativity	• physical pain • outstanding success • boost in freedom • manipulative crying • …

Note. ↯ = frustration of psychological need; ✓ = satisfaction of psychological need; ↑ = high; ↓ = low; ↕ = medium.

Comparing FRC to former crying taxonomies. Our work stands out from previous crying taxonomies by providing (i) a theoretical framework, (ii) a multivariate test of our assumptions, and (iii) evidence that it is reliable. Further, none of the prior taxonomies comprises the exact constellation of categories that we consider crucial. Even though one in four crying episodes was media-related in our studies, this category is only considered in three prior taxonomies (Frey et al., 1983; Kraemer & Hastrup, 1986; Young, 1937). Additionally, some categories of former taxonomies appear thematically very heterogeneous to us. Vingerhoets and colleagues' (1997) third factor comprises tears due to physical pain as well as due to seeing other people suffer and making people disappointed. The category "interpersonal issues" from Frey et al. (1983) also subsumes different triggers. The same applies to Young's (1937) disappointment category, which summarizes tears due to a failed exam and the loss of a loved one.

Another advantage of the FRC lies in the fact that we can draw a theoretical line between emotional crying and crying due to physical pain, which has been considered as a separate category in prior work (Bylsma et al., 2008, 2011; Vingerhoet et al., 1997). As described above, we assume that satisfied/frustrated psychological needs precede emotional crying. This is not necessarily the case for tears associated with physical pain or drug effects. Considering that physical pain is a rare reason for shedding tears in adulthood also speaks against an inclusion in our taxonomy (Vingerhoets et al., 2001).

It is important to note that considering an appraisal-perspective to categorize crying is not a new idea, but has been proposed before (Gračanin et al., 2021; Miceli & Castelfranchi, 2003; Vingerhoets et al., 1997). However, we are the first who consider this idea by developing a theoretically derived taxonomy of crying.

Why do more negative than positive crying categories exist? Our taxonomy contains more negative than positive categories, which is well in line with a phenomenon described by Alves and colleagues (2017): Good is more alike than bad. The authors argue that the information ecology contains more negative than positive information, which can be illustrated with an example. When lying in the bathtub, the temperature of the water can be either pleasant or unpleasant. While a pleasant temperature is between 36 and 38° C, the water can be too cold (< 36° C) or too warm (>38° C). Thus, there are *more* and *more specific* descriptions available to express the uncomfortable temperature of the bath water. This phenomenon seems to reflect a general principle and is observable in various contexts. For example, negative basic emotions outnumber the positive ones. Accordingly, it is not surprising, but even expected, to observe several distinct negative crying categories and only one broad positive one.

FRC and mental disease. Given that we relate the FRC to psychological needs, and considering that the frustration of psychological needs has been related to mental disease (Vansteenkiste & Ryan, 2013), we find it worthwhile to speculate about potential relations between the FRC and mental disease.

Loneliness- and overload-related crying seem related to frustration of needs. Accordingly, we would expect a higher prevalence for loneliness- and overload-related crying within clinical samples. As impotence-related crying is associated with autonomy-frustration and relatedness-satisfaction, the picture is less clear for this category. Harmony- related crying seems associated with need-satisfaction (rather than -frustration), and we would assume a lower prevalence in clinical samples. In the case of media-related crying, we could not come up with a clear assumption. On the one hand, crying from this category seems to be associated with need-satisfaction, which would suggest no elevated prevalence in clinical samples. On the other hand, empirical findings showed that women with depression symptoms reported frequent crying when watching TV/movies (Frey et al., 1983).

Crying is related to various psychiatric conditions (see Bylsma et al., 2021 for a review). A discussion of all pathologies under the lens of the FRC would go beyond the scope of this article. We therefore discuss exemplarily the diagnosis borderline personality disorder (BPD). Patients suffering from BPD cry more frequently than healthy individuals (Peter et al., 2019). Furthermore, meta-analytic evidence suggests that BPD is associated with rejection sensitivity, which in turn seems linked to childhood emotional abuse and neglect (Foxhall et al., 2019). Considering the underlying needs of the FRC, one would expect a particular increase of loneliness-related crying for patients suffering from BPD. As illustrated by this example, the FRC might provide a fruitful approach to better understand crying in the clinical context.

On the relation between crying and well-being. The basic idea of the catharsis thesis is that crying helps one recover from emotional distress. Some researchers assumed that "non-crying" is associated with decreased well-being, which could not yet be verified (e.g., Hesdorffer et al., 2018). We propose that two aspects received too little consideration in this debate. First, and in line with the premise of the FRC, if individuals did not face any reason to cry, one would hardly expect suffering due to non-crying. Accordingly, future tests of the catharsis thesis should capture whether individuals were exposed to distressing stimuli, possibly by drawing on the FRC. Second, cathartic crying is probably not the only way to overcome emotional distress. If individuals use techniques such as cognitive restructuring (Ellis & Dryden, 2007) to cope with adverse circumstances, non-crying and well-being are most likely unrelated. Hence, future studies should also consider coping mechanisms other than crying when examining the catharsis thesis.

FRC and social support intention. A recent large-scale examination uncovered that observing a tearful individual causes the intention to offer social support (Zickfeld et al., 2021). This effect was stronger when crying was triggered by a negative reason. Moreover, the authors found evidence suggesting that the effect was partially mediated through the perceived

helplessness of the crying individual. Considering these findings and Hasson's (2009) idea of tears as a social signal for help-seeking, the FRC might be linked differently to support intentions. Crying due to loneliness, impotence, and overload might be associated with more perceived helplessness and higher support intentions than harmony- or media-related crying.

Pending test of generalizability of the FRC. Given the cultural differences in emotion expression (e.g., Matsumoto, 1990) and in crying (van Hemert et al., 2011), it stands to reason that there are also cultural differences in the prevalence of the FRC, which should be addressed in future studies. Given that we derived our taxonomy from psychological needs, which are assumed to be universal in humans, we expect that the structure—but not the prevalence—of the FRC remains stable across cultures. This assumption, however, requires empirical investigation.

Considering alternative categorizations of emotional crying. We are convinced that a focus on the SDT-needs and the classification of *common* triggers of crying is an appropriate first step. Undoubtedly, future research projects should also focus on less typical antecedents of crying and other needs. A parallel to personality psychology can be drawn. In a first step, it seems appropriate to consider the role the Big5/HEXACO dimensions (i.e., the general construct) when predicting a certain behavior, before adding more specific traits to the equation, such as the dark tetrad dimensions (e.g., psychopathy). In addition, we see several practical benefits by considering the SDT-needs in a first step. In contrast to other need-approaches (e.g., Denissen & Penke, 2008; McClelland, 1985) established state-measurement tools are available to assess the SDT-needs, which enabled us to conduct Study 3. Moreover, the SDT is a very well-known and frequently studied theory, whereby our work is compatible with the knowledge of many potential readers (e.g., Reeve, 2018). Last, we included an empirical test beyond the SDT-needs in our work by considering "self-esteem" as additional need. The empirical evidence

revealed a substantial overlap between self-esteem and competence, which suggests that focusing on the SDT-needs is an appropriate initial step.

Nevertheless, we argue that the FRC is only one way to categorize emotional crying. If another theoretical perspective is applied, researchers might reveal different categories than we did. If one takes a look at personality psychology, for example, different approaches resulted in specific conceptualizations of personality. While lexical approaches such as the HEXACO model (Ashton & Lee, 2007) identified the factors honesty, emotionality, extraversion, agreeableness, conscientiousness and openness, the biologically oriented model proposed by Panksepp contains the factors seeking, play, care, fear, sadness and anger (Panksepp, 2004). Even though the models partially overlap (e.g., seeking corresponds well with openness), there are also points where they seem incompatible (i.e., there is no equivalent for conscientiousness, Marengo et al., 2021). So, in the future it would be exciting to see different models of crying competing, hoping that in the long run the most plausible and parsimonious one with the highest explanatory power will gain general acceptance. It is possible that other analysis strategies might bring alternative crying taxonomies to light. Since our categories partially overlap in their underlying need structure (see Table 11), factor analytical approaches might be especially promising in order to identify the most meaningful model representing crying episodes in a next generation of research. Future work could also investigate whether subcategories can be identified within the media category. In sum, our taxonomy is certainly not perfect, but it represents a theoretically derived and empirically informed step in categorizing antecedents of emotional crying.

Conclusion. We aimed to better understand the phenomenon of crying and therefore developed a reliable taxonomy that captures the most common triggers of emotional crying, the Five Reasons to Cry. We found evidence for our theoretical considerations as we observed relations between loneliness and relatedness-frustration, impotence and autonomy-frustration,

overload and competence-frustration, and harmony and relatedness-satisfaction, as well as media and relatedness-satisfaction. By applying a multivariate perspective to our taxonomy, we found evidence for the distinctness of the FRC. Subjective well-being was highest when individuals' last crying episode was related to harmony, and SWB was lowest when related to loneliness, impotence, or overload. These empirical findings attest to our taxonomy's construct and criterion validity. We hope to stimulate further research on crying by providing a valid taxonomy of its most common situational antecedents.

This part of the chapter corresponded to the article *Five Reasons to Cry – FRC – A Taxonomy for Common Antecedents of Emotional Crying* which was published in *Motivation and Emotion* (Barthelmäs et al., 2022).

5. RESEARCH DESIGNS AND PRACTICES WHEN STUDYING CRYING

In this chapter, the research designs that are typically applied when crying is empirically studied are discussed. *Ambulatory Assessment* is framed as a complementary strategy to gather information about crying and a free software that allows researchers to cost-effectively conduct such studies is presented. In the course of these methodological considerations, my empirical work is evaluated in light of the replication crisis and the application of open science practices.

5.1. Research designs used in the crying literature

Variables that are typically investigated in crying research were discussed in Chapter 3. Now, the study designs used to assess these variables are discussed. Four approaches are most common in crying research. First, in retrospective studies, participants are asked about the frequency, the circumstances, and the consequences of past crying episodes (e.g., Peter et al., 2001). Second, in so-called crying-proneness studies, participants are presented with items describing hypothetical circumstances, and they should indicate how likely they were to cry in response to these stimuli (e.g., Denckla et al., 2014). Third, in quasi-experimental laboratory studies, participants are exposed to sad video clips aiming to induce crying while physiological or affective responses are recorded (e.g., Gračanin et al., 2015). Fourth, in experimental studies focusing on the communicative aspect of tears, participants are confronted with face stimuli that either feature visible tears or do not (e.g., Zickfeld et al., 2021). These study designs have certain advantages and disadvantages. In the following, their major drawbacks will be outlined.

A major drawback of retrospective studies is that results can be distorted through recall biases (e.g., Bradburn et al. 1987, Tversky & Kahneman, 1973), which could result in spurious relations or could mask existing correlations. Crying proneness studies can be criticized because they run the risk of being artificial, i.e., they may have little to do with actual crying, without offering the advantages of experimental procedures (i.e., drawing causal conclusions). Quasi-experimental studies aiming to induce crying in controlled laboratory conditions are only

suitable to a limited extent for illuminating its medium-term or long-term consequences (for an exception, see Gračanin et al., 2015). Since most people typically interact with others with whom they are familiar (Depow et al., 2021), experimental studies confronting participants with tearful vs. tearless faces of strangers may suffer from low ecological validity and cannot be generalized to more naturalistic settings. Considering these drawbacks, Ambulatory Assessment can be considered as a complementary approach when studying crying and will be described in the next paragraph.

5.2. Ambulatory Assessment as a complementary strategy to study crying

Ambulatory Assessment (AA; Trull & Ebner-Priemer, 2013) or ecological momentary assessment (EMA; Stone & Shiffman 1994, Stone et al. 2007; Shiffman et al., 2008) studies can compensate for some of the above-mentioned disadvantages. Studies using these approaches are characterized by the fact that data is collected in participants' everyday lives (Csikszentmihalyi & Larson, 2014). In contrast to crying proneness studies and experimental approaches involving tearful vs. tearless face stimuli, the ecological validity of such studies can be considered as relatively high, since information is obtained while participants are in their natural environments. Given that the time interval between the event (i.e., crying) and its measurement is usually much shorter than in retrospective studies, the probability of retrospective bias is reduced. Considering that such studies typically take place over several days (if not weeks), they are particularly useful for examining consequences of crying in the long run. Another advantage is that the impact of real-world boundary conditions (e.g., being at work vs. being at home) can be examined. Although causal conclusions cannot be drawn as easily as in experimental settings, AA data could provide interesting insights. Multilevel analyses can be used to test how situational variables (level 1 predictors) and person-related variables (level 2 predictors) explain variance in the dependent variable (e.g., Weiss et al., 2021). In view of these advantages, is not surprising that AA studies are applied in various

fields, for example, to study cognitive phenomena like mind-wandering (Stawarczyk et al., 2011), affective concepts like subjective well-being (de Vries et al., 2021), motivational concepts such as flow (Engeser & Baumann, 2016), and topics like interpersonal trust (Weiss et al., 2021), empathy (Depow et al., 2021), schizophrenia (Mote & Fulford, 2020), or physical activity (Kanning & Schlicht, 2010).

At the same time, it must be emphasized that AA studies can also be associated with difficulties. The results of an AA study can be generalized to typical daily life experience only if respondents compliantly participate. If the proportion of non-responses is too high, then it must be questioned how ecologically valid the study is. Eighty percent is a threshold that is often referred to in the literature (e.g., Trull & Ebner-Priemer, 2020). Reactivity is another critical aspect of AA that researchers should keep in mind. It can be defined as a change in experience and/or behavior due to the act of measurement. While studies suggest that AA studies are not particularly prone to reactivity effects (Macintyre et al., 2021; Shiffman et al., 2008), it can be assumed that its magnitude might depend on the specific content of the study.

Ambulatory Assessment cannot be regarded as one specific research design (Shiffman et al., 2008). It seems more appropriate to consider AA as an umbrella term that allows inclusion of different research designs such as single self-report assessments per day, i.e., diary studies (Bylsma et al., 2011), multiple self-report assessment per day (Engeser & Baumann, 2016), and the continuous assessment of psychophysiological parameters such as ECG (Schwerdtfeger & Rominger, 2021). In diary studies, participants usually receive one survey in the evening hours, and the burden for participants is assumed to be relatively low (Shiffman et al., 2008). When conducting studies with multiple self-report assessments per day, different sampling options are available (Shiffman, 2008). When time-based sampling is applied, participants receive surveys at fixed times or within certain time windows throughout the day. When event-based sampling is applied, the occurrence of a pre-defined event (e.g., whenever one smokes a cigarette) triggers

the survey. Time-based and event-based sampling could also be combined. Originally, AA studies were conducted analogously by providing participants with surveys in paper and pencil form and an alarm (in case of event-based ESM studies; Shiffman et al., 2008). Currently, most of such studies are conducted digitally via participants' smartphones. Digitization of these techniques brings many advantages; for example, participants do not have to carry stacks of paper with them. However, the digital implementation of such studies also poses several pitfalls. Software that researchers can use freely is often restricted to one operating system (iOS or Android). This restriction could result in selective samples, which contradicts the goal of testing the generalizability of effects in everyday life. Free software, which requires participants to install a related app, is limited to the following regard. Researchers must trust developers to keep their app functional for all software and hardware constellations. If this is not guaranteed, this could result in selective sampling, too. Software that functions across devices is usually offered commercially. Accordingly, there is a gap regarding free and reliable software to conduct AA studies. Although AA has been available for some time, there has been no published study using an *electronic* diary to approach crying (please note, previous diary studies on crying were conducted as paper-pencil studies: Bylsma et al., 2011; Frey et al., 1983). A free software to conduct electronic AA studies is presented in the next paragraph.

5.3. Telegram-Survey-Bot: A free software to conduct ambulatory assessment studies

The following part of the chapter corresponds to the article *Using a Telegram chatbot as cost-effective software infrastructure for ambulatory assessment studies with iOS and Android devices* which was published in *Behavior Research Methods* (Barthelmäs et al., 2021).

5.3.1. Theory

Ambulatory Assessment (AA) studies can test psychological theories in everyday life. This offers the opportunity to evaluate the generalizability of theories and to examine boundary conditions, which cannot be examined in the laboratory (cf. Fahrenberg, et al., 2007; Trull &

Ebner-Priemer, 2014). Hence, AA studies are one important tool to improve the understanding of human experience and behavior by capturing self-reports (e.g., Engeser & Baumann, 2016), observations (e.g., Ellis-Davies et al., 2012) as well as motoric (e.g., Tryon, 2005) and physiological signals (e.g., van Lier et al., 2020) in the field. For about a decade, AA studies that focus on self-reports are typically implemented via participants' smartphones (e.g., Killingsworth & Gilbert, 2010). Given the fact, that more and more people possess a smartphone (cf. Miller, 2012), the feasibility of such studies should improve, however, carrying them out is still associated with a number of restrictions and pitfalls.

Table 12. *Exemplary overview of software solutions for AA-studies.*

Software	Operating System	*Costs*	*Special Features*
PIEL Survey	Android & iOS	Free	Data is stored at participants' phone and must be sent to researcher at the end of the study.
Lifedata	Android & iOS	Fee-based	Allows responses from one person to trigger questions sent to a "partner"
SurveySignal	Android & iOS	Fee-based	Survey links are provided via SMS
Experimetrics	Android & iOS	Fee-based	Basic version is free
mEMA	Android & iOS	Fee-based	Participants can upload images, videos and audio files
Moviesens	Android	Fee-based	Option to collect physiological data
ESM Capture	iOS	Fee-based	-

Note. This overview does not claim to be comprehensive.

First, most of the available software solutions to conduct such studies are fee-based and therefore inaccessible to researchers or students with insufficient financial resources (see Table 12 for an exemplary overview of software solutions for AA studies). Second, the development and maintenance of self-made smartphone applications to run such studies can consume many resources which means that this option is also not feasible for all researchers or students. Third, in order to collect non-selective samples, it would be ideal if all owners of a smartphone could participate in an AA study, regardless of the hardware and software (i.e., iOS or Android) they use. If participants use their own smartphone for participation (and no study smartphone is provided), there may be incompatibilities between the study software and participants'

smartphones (cf. Trull & Ebner-Priemer, 2020), which limits the selection of possible participants. Fourth, participants might be concerned regarding the protection of their data and they could perceive the installation of an AA application on their private phone as an intrusion on their privacy, as applications can potentially collect a variety of information, like the number of incoming calls, GPS-information or total time of smartphone usage (cf. Miller, 2012).

In this paper, we present a costless approach that provides researchers with an option to collect ambulatory self-reports conveniently and reliably. Using this approach, participation is possible with iOS- and Android-devices, while data security for participants is ensured. We use the cloud-based instant messaging service Telegram as platform to conduct AA studies. Specifically, we use a Telegram chatbot (i.e., a software that conducts simple and automated conversations via textual methods) to provide participants with surveys in their everyday lives. We control the actions of this chatbot through a python script, which allows researchers to set up study designs both flexibly and user friendly. This script can be edited under Windows, macOS and Linux and can therefore be used by almost anyone. In the following paragraphs, we outline what requirements our approach has for participants, what demands are made on researchers, how our approach works in detail and how to set up a study with our approach.

How our approach works for participants. To take part in a study with our AA approach, participants must meet the following requirements: (a) possession of a smartphone (with Android or iOS operating system), (b) Telegram-Messenger App available or willingness to install it, and (c) availability of permanent mobile internet access to receive messages from the chatbot and to open the online-survey links. If participants meet these requirements they are instructed to add the study-chatbot into their Telegram-contact list. By subscribing the chatbot, participants do not have to unfold personal data, so neither their telephone number nor the Telegram username are stored. When the study begins, this chatbot sends messages to participants' smartphones containing online-survey links.

How our approach works for researchers. To run a study with our AA approach, researchers need (a) to create a Telegram chatbot-account, (b) a software that can present online-surveys at participants' mobile devices and (c) a computer/server that configures the actions of that chatbot through our python script. This computer can use Windows, macOS or Linux as our python script works independent of the operating system. Further, this computer/server needs a constant internet connection and must run continuously while a study is conducted. We provide convenient download versions of our script. Importantly, our script is licensed under GPLv3, which means that it is freely available and that it can be modified by others, but must be freely available again after modification.

In the following sections, we explain the functioning of our AA approach in detail and describe the editable features of the chatbot. We further discuss how to set up an AA chatbot when Linux is used as operating system for the server that controls the action of the chatbot. Please note, we do not elaborate on which software should be used to present online-surveys.

Components of our approach. Our python script is the centerpiece of our approach and consists of three components: The configuration handler, the database handler and the bot component itself. The script can be configured using a JSON[12] file. In this configuration file, researchers can enter attributes like the survey-links, the dates and times for scheduling the surveys and the API-[13]token (see Figure 11). The database is necessary, as a Telegram chatbot only sends messages in response to a user request. For our purpose, however, it is essential that the chatbot sends messages to chats at specific times without immediate user request. We therefor use a SQLite[14] database, which allows to store the individual chat IDs of participants and to contact them through the Telegram bot API.

[12] Javascript Object Notation: A lightweight data-interchange format.
[13] Application Programming Interface: An interface between different parts of a computer program. Specifically, the API-token allows our python script to communicate with one specific Telegram chatbot-account.
[14] SQLite: A relational database management system contained in a C library.

We now describe the sequence of actions using the example of a daily survey, i.e., a survey-link that is sent to participants multiple times throughout a study (see Figure 9).

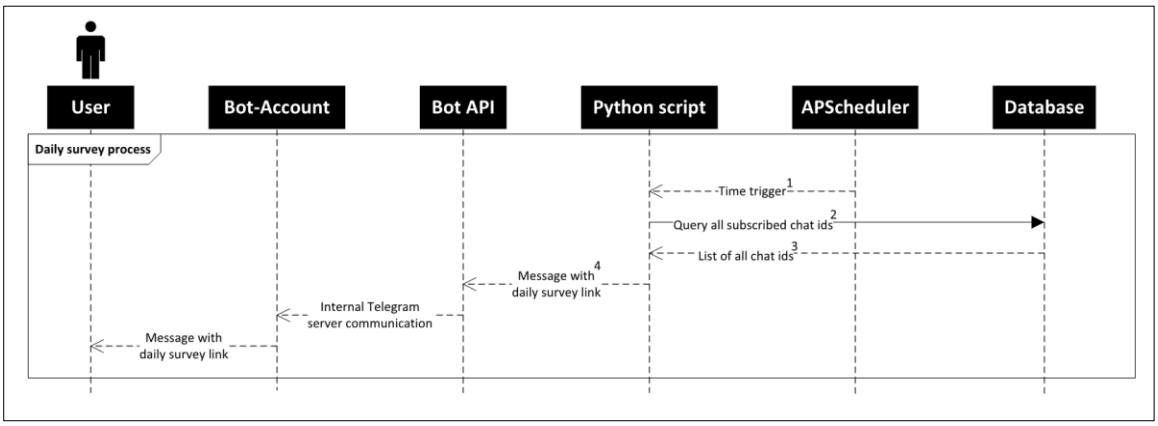

Figure 9. Sequence of actions providing participants with a daily survey link. Our script is accountable for steps (1) to (4), subsequent steps are executed by the bot API (Barthelmäs et al., 2021).

Let us assume that our participants are already subscribed to the chatbot, which means that their anonymous chat ID has been already stored in the database: (1) Based on the configuration file entries that can be edited by the user, the APScheduler package provokes time triggers. (2 + 3) The python script then queries all subscribed chat IDs from the database. (4) Following, the python script sends a survey link to the bot API which delivers the survey link to all subscribed chat IDs via the bot-account.

Available settings in our approach. Researchers can adjust various parameters in the configuration file to set up a study. As AA studies typically consist of a start survey, a daily survey and one or more end surveys, the configuration file offers placeholders for the respective links of these surveys. Further, researchers can decide whether there is a fixed start date for all participants to begin with the study, or whether participants can start with the study flexibly within a given time period. Participants can also be randomized into different groups allowing to provide different groups with specified start, daily and end surveys, which enables experimental AA studies. Daily surveys can either be sent to participants at fixed times or depending on the time of getting up. Time lag between two survey links can be kept constant or

fluctuate within a certain interval. Further, it is possible to provide participants with the option to request survey links on demand, which allows conducting event-based AA studies. Finally, researchers can send out multiple end surveys, hence, follow-ups can be scheduled flexibly.

How to set up an AA chatbot with our script under Linux. In this paragraph, we describe the steps to set up an AA study when the server that controls the actions of the chatbot runs with Linux (even though we offer Windows- and MacOS-versions of the script, we recommend using the Linux-version). Specifically, we describe the setup when using *Ubuntu Server* as Linux distribution and the terminal multiplexer *tmux*. The sequence of the setup procedure is depicted in Figure 10.

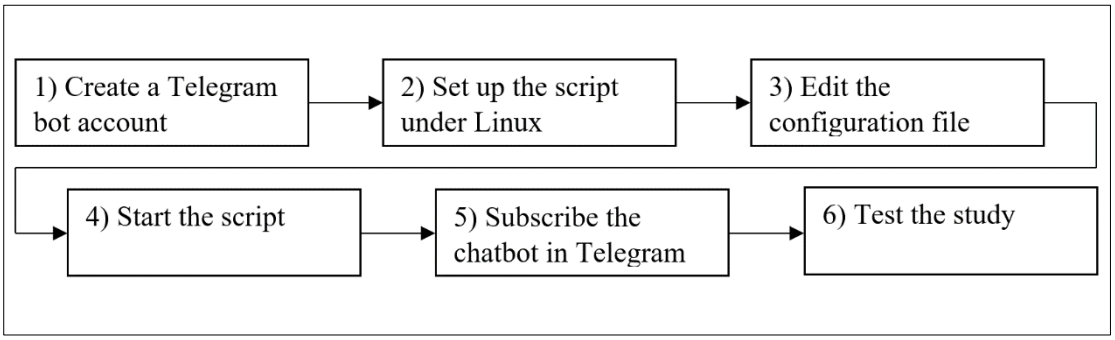

Figure 10. Sequence of actions that are necessary to set up an AA chatbot under Linux (Barthelmäs et al., 2021).

(1) Create a Telegram bot account: Open Telegram with a smartphone-, web- or desktop-application. A Telegram bot account can be created and configured with the so called *BotFather*. To start a conversation with the BotFather, add the *@botfather* account in Telegram. A new bot is created entering the command */newbot*. You will then be asked to give the bot a name and a username. The name will be displayed in the contact list. The username is unique and ensures that the bot can be identified. After naming the bot, you receive the API-token which allows our python script to communicate with the bot. To make using the bot easy, relevant commands to control the bot can be suggested. This is done with the command */setcommands* and can contain the following features: subscribe - subscribe to the survey; unsubscribe - unsubscribe from the survey; help - send me help; survey - send me a daily survey.

(2) Set up the script under Linux: Download the latest release of our script from https://github.com/Raze97/Telegram-Survey-Bot/releases/. Unzip the file to a folder location of your choice.

(3) Edit the configuration file: The file *config.json* is located in the directory *config* and allows to edit the settings for an AA study. Open the configuration file with the editor of your choice (e.g., nano) and adjust the settings according to your needs. Using a simple fictitious study, we demonstrate how this editing process works in principle. Figure 11 shows how a corresponding configuration file would have to look like. In the following description of the study, the numbers given in square brackets correspond with the code line that allows adjusting the respective feature in the configuration file (Figure 11). It is important to note, however, that Figure 11 does not show a complete but only a reduced configuration file for demonstration purposes. Please note that our script only works with a complete file. You can find the latest documentation of the complete configuration file under: https://github.com/Raze97/Telegram-Survey-Bot/wiki/Instruction-Linux#The-config-file. Let us assume that we want to set up the following study: Participants are allowed to start with the study between July 1st 2020 and July 31st 2020 [code line: 2, 3]. They are asked to fill in a start-survey which queries demographic variables directly after participants subscribed the bot [cl: 28]. The message delivering the start-survey is available for 15 minutes [cl: 18]. Participants' mood is captured on three consecutive days, beginning one day after subscription [cl: 6], at eight times per day [cl: 12]. Participants receive messages with mood-surveys depending on the time of getting up [cl: 9, 31]. They receive their first mood-survey 30 minutes after they got up [cl: 11] and then, every 90 minutes [cl: 13]. The interval between two surveys is not fix, but randomly varies between 80 and 100 minutes [cl: 23]. Each message containing a link to a daily mood-survey is visible for 30 minutes [cl: 19], afterwards it is deleted. At the evening of the last survey day [cl: 7], participants receive one end-survey [cl: 15] 30 minutes after the last mood-survey [cl: 14]. This end-survey contains

a personality questionnaire [cl: 34] and the message delivering it is visible for 45 minutes [cl: 20]. Study-specific texts help to make participation as pleasant and comprehensible as possible [cl: 37-51]. The API-token received from Telegram must be copied in to the corresponding field [cl: 1].

```
{
    "api_token": "<API token you received from the botfather>",
    "subscription_start_date": "2020-07-01 00:00",
    "subscription_deadline": "2020-07-31 00:00",
    "useDayCalculation": true,
    "dayCalculationSettings": {
        "daily_SurveyDays": [1, 2, 3],
        "end_SurveyDays": [3]
    },
    "useTimeCalculation": true,
    "timeCalculationSettings": {
         "daily_DelayMinutesAfterWakeup": 30,
         "daily_SurveysPerDay": 8,
         "daily_DelayMinutesBetweenSurveys": 90,
         "end_DelayMinutesAfterWakeup": 780,
         "end_SurveysPerDay": 1,
     },
     "linkDeletionSettings": {
         "start_DeleteDelayMinutes": 15,
         "daily_DeleteDelayMinutes": 30,
         "end_DeleteDelayMinutes": 45,
    },
    "randomTimeShiftSettings": {
      "daily_RandomTimeShiftMinutes": 20,
      "end_RandomTimeShiftMinutes": 0
    },
    "urls": {
        "start_url": [
            "https://www.demographic-survey.com/"
        ],
        "daily_url": [
            "https://www.mood-survey.com/"
        ],
        "end_url": [
            ["https://www.personality-survey.com/"]
        ],
    },
    "texts": {
        "welcome": "Welcome to our study. Please enter or click
          /subscribe to participate.",
        "subscribe": "Please fill out the Start-Survey first.
         Starting tomorrow morning you will receive survey links
          several times a day.",
        "subscribe_wakeup_time": "Please tell me your wakeup time
          in the format",
```

```
45          "unsubscribe": "You do not longer participate, you can now
46            delete this chat from your contact list.",
47          "daily_reminder": "Hi there, it is time for a mood
48            survey.",
49          "end_reminder": "Hi, it is time for the end survey.  Once
50            you have completed this survey, you can unsubscribe from
51            the study by entering /unsubscribe.",
52          }
53}
```

Figure 11. Excerpt from the configuration file, which allows controlling the actions of the chatbot. For demonstration purposes, we depict a reduced config.json-file here. Please note that our script only works with a complete file (Barthelmäs et al., 2021).

(4) Start the script: After editing the configuration file, switch back to the directory where the *config* folder is located. Make the Survey-Bot file executable with the command: *sudo chmod +x Survey-Bot.* To let the bot run in the background, the terminal multiplexer *tmux* can be used (please note, that under Linux there are also other terminal multiplexer options available). A new tmux-window can be opened with the command: *tmux*. Run the bot with the command: *./Survey-Bot*. To detach the tmux-window use the key-combination: *ctrl + b, d*. In case you would like to stop the bot, use the key combination: *ctrl + c* and close the connection with: *logout.* To keep overview of the *tmux*-windows, assign a name to the window. To do this, the index number of the tmux-window must be queried with the following command: *tmux ls.* You can rename the tmux window with the command: *tmux rename-session –t <index number> <name>*. To check whether the bot is still running, enter the command: *tmux attach –t <index number or name>*.

(5) Subscribe to the chatbot in Telegram: Open the Telegram application and add the chatbot to your contact list. To do this, search for the unique username you have assigned to the chatbot. Press *Start* and enter the command */subscribe* to subscribe the chatbot.

(6) Test the study: We recommend a test run to check whether the chatbot really functions as intended. If the test run is positive, the actual study can be started. Researchers can remain subscribed to the chatbot even during the real study and can thus keep an eye on whether

it is running as desired. If you want to unsubscribe the bot, enter the command */unsubscribe* and delete the bot from your contact list.

5.3.2. Study 5

We conducted a small pilot study using our approach. The aim of this study was to get a first impression of whether our approach works as planned and how participants evaluate it. In terms of content, we examined the experience of flow in everyday life (cf. Csikszentmihalyi, 1975) on three consecutive days. Since the content of the study is not of relevance in the present context, we limit the report of the study results to respondents' evaluation of our approach.

5.3.2.1. Method

Participants. We tried to recruit as many participants as possible from a psychology course. This resulted in a sample of $N = 15$ (11 = women, 3 = men, 1 = other; $M_{age} = 23.4$, $SD_{age} = 2.34$). All participants started the study at the same day. All participants possessed a smartphone with constant connection to the internet and were willing to install Telegram-Messenger or were already using it. The sample consisted of iOS-users (N = 4) and Android-users (N = 11). All participants agreed to an informed consent and received a chocolate bar as compensation.

Procedure. Participants subscribed to the study chatbot during the course and filled out a start survey containing an instruction to create an individual participant-code. The initial survey also contained several psychological scales and questions regarding demographic information. On the three following days, participants received eight survey links daily between 9 am and 9 pm. The interval between two survey links randomly fluctuated between 50 and 130 minutes (i.e., 90 minutes on average). The content of these daily surveys was identical for each measurement point. To ensure matching between different measurement points, participants' code was queried at the beginning of each daily survey. At the evening of day three, participants

received an end survey link, which gave them the possibility to evaluate our AA approach. Unipark survey-software was used to create all online surveys.

Evaluation of our AA approach. We asked participants to evaluate our AA approach with open response format questions and with five closed questions. A sample item for a closed question is, “The surveys did not bother me in my everyday life”.

5.3.2.2. Results

Table 13. *Evaluation of our AA approach.*

Question	*Mean*	*SD*	*Median*
(1) The surveys did not bother me in my everyday life.	3.77	0.73	4.00
(2) The surveys have kept me from important activities in my everyday life.	1.92	0.76	2.00
(3) It was hardly possible to complete all the surveys.	2.54	1.13	3.00
(4) I enjoyed participating in the study.	3.38	0.96	4.00
(5) I would not participate in such a study again.	2.38	1.26	2.00

Note. N = 13 (two participants did not fill in the end survey). Responses were given on a 5-point Likert scale ranging from *not at all true (= 1)* to *completely true (= 5)*.

The compliance rate was satisfying as participants replied to 87% of the daily surveys. In course of three days, 360 surveys were sent out to participants. These surveys were answered in 314 cases. There was no data loss due to technical problems.

Evaluation of our AA approach. Participants indicated that the survey did not bother them in their everyday lives. The descriptive statistics for the evaluation-items are depicted in Table 13. Participants needed 83s (*SD* = 50.77s) on average to answer a daily survey. The feedback on the open response format questions was consistently positive. While one participant for example said, that eight surveys a day were too many, two participants explicitly stated that eight surveys a day were fine.

5.3.2.3. Discussion

Running an AA study poses a challenge in many ways. We took efforts to circumvent some of the main challenges in the process to realize AA studies via smartphones by providing

a costless python script that allows researchers to collect ambulatory self-reports conveniently and reliably with a Telegram chatbot. The results of our pilot study suggest that participants generally accept our approach, when ambulatory self-reports are collected via Telegram. We further demonstrate that our approach is a valid method to self-reports are collected via Telegram. As the examined sample was rather small and therefore the results are essentially qualitative in nature, future studies should conduct further evaluations with larger samples using our approach.

Our approach is a flexible AA tool, as our script allows adjusting the following parameters: (a) placeholders for a start, daily and end survey link, (b) fixed or variable start date of the study, (c) randomization of participants to *n* different groups allowing to provide *n* groups with specified start, daily and end surveys (which enables experimental AA studies), (d) definition of fixed time-points for daily surveys, (e) possibility to use participants' usual wake-up time to schedule daily surveys individually, (f) option for participants to request surveys on demand. Further, participation is possible with iOS- and Android-devices.

The requirements to use our AA approach are manageable both for participants and for researchers. Besides our python script, researchers need (a) to create a chatbot-account, (b) a software that can present online-surveys at participants' mobile devices and (c) to setup a computer/server that configures the actions of that chatbot through our python script. Although, our approach is not a complete solution for AA studies (i.e., surveys must be prepared on a separate platform), its implementation is rather easy, as many researchers already have access to an online survey software (cf. Sassenberg & Ditrich, 2019). In addition, only limited resources are needed to create a chatbot-account and to set up a computer/server as platform for our python-script as it can be edited under Windows, macOS and Linux. To take part in a study using our approach, participants need (a) to own a smartphone, (b) to be willing to install Telegram-Messenger and (c) a constant connection to the internet. As already described, the

number of smartphone users and access to mobile internet is constantly growing (cf. Miller, 2012), which will make recruitment of large sections of the population ever easier.

It is important to emphasize that we do not want to advertise Telegram. Our only goal is to provide a reliable infrastructure for AA studies using participants' smartphones. Telegram seems to be an appropriate means to realize AA studies for the following reasons: (a) Participants are provided with software-updates for the messenger application which renders our approach compatible with different hardware and operating systems even in the long run, (b) users have the option to keep their personal data largely undisclosed (i.e., users can deny Telegram access to their contacts), (c) compared to *WhatsApp*, the implementation of chatbots is possible and supported, and (d) the implementation effort for our approach was minimal, since we only had to program the back end. That is, we only programmed the functions that run in the background of the software. It was not necessary to develop the front end, like a graphical user interface (i.e., an app) or to manage notifications. Additionally, we did not have to go through the effort of publishing an app.

One decisive advantage of our approach lies in the separation of the reminder-infrastructure (Telegram) and the survey-infrastructure. That is, participants get a reminder to fill in a survey via Telegram, but they do answer the surveys on a different platform. Accordingly, no survey information is passed on to Telegram. Furthermore, researchers using our approach are never in the position to access other contents of participants' mobile devices. Moreover, it is not possible for participants to communicate with other participants via the chatbot.

Comparing our approach to already existing tools, the main advantages are the user-friendly and cost-free use, the data security level, and the fact that both Android and iOS users can participate. To the best of our knowledge, PIEL survey is the only feasible cost-free AA tool currently on the market. While PIEL survey has the advantage that data can also be

collected if the participant does not have access to the internet, this presupposes that participants independently send their data to the researcher at the end of the study, which comes with the risk of a complete data loss. Furthermore, participants' personal data and their answers to the survey are less sharply separated than it is the case in our approach, as the PIEL survey application is installed on participants' smartphones.

Another important feature of our approach is that it is licensed under GPLv3. This means that third parties have free access to our code and can modify it as needed, but they commit themselves to make their code freely available again. This way we have laid the foundation that our approach can be further developed and improved (and at the same time remains freely available), a process to which we enthusiastically invite interested colleagues. A possible development of our approach could include, for example, that surveys can be carried out directly in Telegram and not via additional survey software whereby, of course, data protection for the participants must be guaranteed.

Conclusion. In sum, we think we have taken an important step forward by rendering the essential research method of Ambulatory Assessment via smartphones available to many researchers and students who previously had no chance of conducting such studies.

This part of the chapter corresponded to the article *Using a Telegram chatbot as cost-effective software infrastructure for ambulatory assessment studies with iOS and Android devices* which was published in *Behavior Research Methods* (Barthelmäs et al., 2021).

5.4. Comparing retrospective and ambulatory crying data

To compare retrospective and ambulatory crying data, it would be ideal to study the same sample using both methods, i.e., participants fill in an electronic diary for one month and they complete a retrospective survey after their last diary entry. Unfortunately, I cannot present this kind of data, however, I can compare data from two samples which were examined with

different research methods. The following comparisons should be treated with caution as it is unclear to which causal factor the differences are due.

In Chapter 4, some of the results of an electronic diary study on crying were described that involved various trait- and state-measures (for the description of the study see Chapter 4.5.1 Materials and Methods). The study provided first evidence that the structure of the FRC was similar whether crying was assessed retrospectively or ambulatory, however, different prevalences for the crying categories were observed. Impotence-related crying occurred six times more often in the retrospective study. This category includes, for example, crying in reaction to the death of a friend. One might conclude that the occurrence of such episodes is overestimated in retrospective surveys, possibly because such episodes are more prototypically associated with the concept of crying. Given that two samples are involved in this comparison, it is also possible that the difference is due to the different samples.

The dairy study also comprised a measurement of the HEXACO model. When crying frequency was assessed on a daily basis, a positive correlation between CF emotionality emerged ($r = .29$, $p = .004$), which aligns with the results of the retrospective study reported in Chapter 3. For the other HEXACO dimensions, no relations to CF could be observed. Given the small sample size of the diary study, several explanations can be considered for this observation. First, it is possible that statistical power was too low to detect the relations. A post hoc power analysis yielded that the study had a power of $1\text{-}\beta = 0.37$ to detect a correlation of $r = .17$ between CF and extraversion. Second, crying is subject to age-related variation (Gračanin et al., 2018) and the retrospective sample was on average more than 10 years older; thus, this sample difference also comes into question to explain the observation. Third, another alternative is that there is simply no relation between CF and other personality traits than emotionality. This would mean that correlations between personality traits (except emotionality) and crying frequency are overestimated in retrospective studies. Considerations and evidence from studies on subjective

well-being support this assumption. Kahneman et al. (2004) found that income was positively associated with life satisfaction, while "net affect" (the difference between positive and negative affect, which was pseudo-momentarily assessed with the day reconstruction method) was almost unrelated to income. The authors interpreted this pattern as support for the focusing hypothesis, which proposes that the relation between life circumstances and life satisfaction is overestimated due to how life satisfaction is assessed (Schkade & Kahneman, 1998). Asking somebody how satisfied s/he is with her/his life is likely to trigger comparison standards like, "I am richer than most others, so I should be fine", which in turn suggests a relation between income and subjective well-being that has only little to do with the in-situ experience. Schwarz and Xu (2011) found similar results when examining the hedonic experience of driving differently priced cars. When participants were asked to evaluate their most recent commute to work (i.e., episodic assessment), hedonic experience was independent of whether participants drove a luxury or an economy car, but when respondents were instructed to predict their experience when driving a BMW, Honda Accord, and a Ford Escord, they reported higher hedonic experience the more the car was worth. When instructed to rate their general experience while driving their car (i.e., retrospective recall), participants also reported more positive emotions the more valuable their car was. Similar processes might be at work when crying frequency is retrospectively assessed, that is, CF assessed in-situ might differ from retrospectively recalled CF. In sum, a study with a sufficiently large sample that combines dairy, and retrospective techniques is necessary to evaluate the validity of retrospective crying studies.

5.5. Evaluation of my empirical work from an open science perspective

About ten years ago, trust in psychology as a scientific discipline was shaken. Cases of scientific fraud such as that of Diederik Stapel became public (e.g., Wicherts, 2011), and an intense debate about questionable research practices (QRPs) and increased type-I error rates emerged (Simmons et al., 2011). Additionally, replication projects questioned the reliability of

findings from psychological science (Open Science Collaboration, 2015). The application of open science practices aiming to remedy reproducibility and replicability issues in psychological science can be understood as a reaction to these incidents (Shrout & Rodgers, 2018). The open science practices, and their relevance, that found consideration in my work will be discussed in the following; specifically, the value of pre-registrations and the sharing of data, code, and materials will be discussed.

Open science practices aim at a state where readers of scientific papers do not have to blindly trust that a research project has been carried out properly, but where they can themselves evaluate the quality of certain aspects of a study (Crüwell et al., 2019). The reward structure in academia creates the incentive to publish as many positive findings as possible (Bakker et al., 2012; Munafò et al., 2017). This circumstance probably contributed to the rise of procedures in the scientific workflow that have been summarized as *questionable research practices* (QRPs; Simmons et al., 2011), which involve the following strategies: measuring multiple potential dependent variables and making an outcome-based selection (i.e., according to statistical significance); flexibly stop or continue data collection depending on whether the central analysis of a study falls below the significance level of $p < 0.05$ (i.e., *p*-hacking); outcome-based (vs. theory-based) inclusion of covariates (i.e., another form of *p*-hacking); systematic exclusion of experimental conditions or post hoc exclusion of certain participants (i.e., another form of *p*-hacking); HARKing, which stands for *hypothesizing after the results are known* and means that post hoc hypotheses are presented as if they had been generated a priori. In essence, these practices produce false-positive results, which increases the likelihood of these results being published.

Constraints on researchers' degrees of freedom in a study project can be seen as a key strategy against the use of QRPs (e.g., Wicherts et al., 2016). Pre-registration of studies is probably the most important policy in this context (Shrout & Rodgers, 2018). It means that

researchers specify the main aspects of their study before data is collected (Wagenmakers et al., 2012): This includes the specification of a-priori hypotheses, how these hypotheses are tested (e.g., whether covariates will be included in the analysis), how the main dependent variable is operationalized, whether and how participants are excluded from the analysis, how many participants are tested and which stopping-rule is applied (for an illustration, see https://aspredicted.org/). Pre-registrations thus prevent the application of several QRPs (Crüwell et al., 2019).

Sharing research data has been uncommon until recently (Houtkoop et al., 2018). However, publishing research data, code, and the materials offers significant advantages for the scientific community (Klein et al., 2018): If a detailed description of the used materials is openly available, this facilitates the conduction of replication studies (i.e., the study is repeated, and new data is collected). Even though there is debate about whether replications are necessary and in which form (Zwaan et al., 2018), it seems fair to state that successful direct replications can increase the level of trust that is placed in a specific finding (for a direct replication of the door-in-the-face technique, see Genschow et al., 2021). Furthermore, conceptual replications can test whether an effect is generalizable to other boundary conditions (e.g., other samples or other measures). For both forms of replications, sharing of the original material is essential.

My work complies with the open science standards described above. Hypotheses were pre-registered before collecting data, sample-sizes were predefined (i.e., setting up a predefined stopping-rule), and data, code, and materials were shared. This substantiates that my empirical results are not the result of QRPs, but of a prior theorizing, proper collection of data, analysis, and reporting. Further, technology to collect data in participants' everyday lives is offered for free. I hope that these circumstances increase confidence in the robustness of my findings and thus increase the chance that described relations will be examined in future studies.

5.6. Summary of the research designs and research practices when studying crying

Emotional crying has been approached through different research designs, including retrospective, quasi-experimental, experimental, and so-called crying proneness studies. Each has certain advantages and disadvantages, although in the case of crying-proneness studies, the cons seem to outweigh the pros (see my critique in Chapter 4). Retrospective studies are easy to conduct and allow to test even small effects, since sufficiently large samples can be recruited. This also makes them particularly suitable for a first test of a hypothesis concerning crying. Quasi-experimental studies that attempt to induce tears under controlled laboratory conditions offer the advantage of approaching causal inferences about emotional tears, while experimental studies confronting participants with tearful vs. tearless face stimuli allow the drawing of causal conclusions about the social signal function of crying. In view of the disadvantages of the methods (i.e., recall biases and lack of ecological validity), Ambulatory Assessment was framed as a complementary method to approach emotional crying and a software was presented that can be used for free to conduct such studies. Comparing AA and retrospective data revealed that an everyday view of crying is relevant because retrospective approaches may lead to an overestimation of certain tear-triggering events. Moreover, it should be emphasized that AA also holds disadvantages. Due to multiple assessment, results might be biased due to reactivity effects. In addition, results from AA studies can only be considered as ecologically valid or generalizable when participants answer most of the surveys they receive. The development of open science practices was discussed that can be seen as countermeasures of questionable research practices and evaluated my empirical work as positive against this background.

6. GENERAL DISCUSSION

The aim of the present dissertation was to analyze situational antecedents, person-related boundary conditions, and intra- and interpersonal consequences (i.e., the ABC) of adult emotional crying. This analysis involved various theoretical considerations and data from 5 studies with a total of $N = 1746$ participants. In Chapter 1, the established definition of emotional crying was expanded. The expansion included the incorporation of appraisal theoretical considerations on emotions (e.g., Scherer & Moors, 2019) and the idea that emotional crying might be related to the frustration/satisfaction of psychological needs. Specifically, it was proposed that the shedding of emotional tears can be understood as an expressive behavior within an emotion episode that involves the satisfaction/frustration of psychological needs like, relatedness, autonomy, and competence (Deci & Ryan, 2000). Further, the anatomical basis and the partly contradictory findings concerning the neuronal correlates of shedding emotional tears were discussed.

In Chapter 2, the most prominent ideas regarding the functionality of emotional tears were reviewed. Some hypotheses can be considered as rejected, e.g., the assumption that interpersonal effects of tears are mediated by pheromones (Gelstein et al., 2011) or that lacrimal glands have a cleansing function similar to kidneys (Frey, 1985). Other ideas were supported by empirical data. Zickfeld and colleagues (2021) demonstrated that observing tears (vs. no tears) triggers the intention to help, and that crying individuals are perceived as warmer than non-crying ones. The effects on the competence perception of crying individuals seem to be much more heterogeneous (Wróbel et al., in press). When examined in everyday life (Bylsma et al., 2011) or observed over a longer time span (Gračanin et al., 2015), the available evidence suggests that tears can comprise a cathartic effect for the crying individual.

In Chapter 3, it was examined how person-related variables, like personality traits, attachment style, and depression, are associated with emotional crying. My retrospective study

suggests that emotional and disintegrated individuals cry more frequently than their respective counterparts, while extraverted (vs. introverted) individuals cry less frequently. Further, indicators of subjective well-being were negatively associated with crying frequency. Some persons seem to benefit more from crying than others, namely honest, extraverted, and agreeable individuals. Work by other authors shows that attachment avoidance is negatively associated with crying frequency, while attachment anxiety is positively associated with it (Fiori et al., 2017; Laan et al., 2012). While the DSM 5 only considers tearfulness a cardinal symptom of depression (American Psychiatric Association, 2013), the available data suggests a curvilinear relation between crying and depression: Depression can be related to an increase of crying frequency, but some individuals seem to lose their ability to shed emotional tears during depressive episodes. An explanation of when which case occurs is still pending.

In Chapter 4, a taxonomy was proposed and tested which allows categorization of different triggers of emotional crying. Such a taxonomy seems necessary because different antecedents of crying are often lumped together, even though the respective episodes differ massively. My studies suggest that five forms of crying occur most commonly, namely loneliness-, impotence-, overload-, harmony-, and media-related crying. It was demonstrated that this taxonomy is reliable and contains criterion validity. These findings underscore that crying should be conceptualized as a behavioral expression in an emotion episode. Moreover, it illustrates how motivation theories (i.e., the self-determination theory; Deci & Ryan, 2000) and emotion theories (e.g., appraisal theories; Scherer & Moors, 2019) can be fruitfully combined to explain human behavior and experience. Considering basal psychological needs, such as relatedness, autonomy, and competence could offer innovative perspectives in the study of many psychological phenomena and processes. Similarly fruitful might be consideration of the perspective that cognitive appraisals play a key role in the emergence and unfolding of emotion episodes (Scherer & Moors, 2019). Although this idea gained widespread consensus in

clinical psychological research and clinical practice years ago (e.g., Beck, 1967), the present work showed that this perspective has so far received too little consideration in some areas of basic research.

In Chapter 5, pros and cons of research designs that are typically used when crying is empirically examined were outlined. Ambulatory Assessment was framed as an alternative strategy to approach emotional crying, which allows to circumvent some of the disadvantages of established research designs and a free software tool to conduct such studies was presented. Further, my work was evaluated from an open science perspective.

The following paragraphs of the discussion will be organized as follows. First, the limitations of my work will be outlined and possibilities for how future work could address them are discussed. Second, implication for other forms of emotion expressions are discussed. Third, the question is posed of whether crying simply corresponds to failed emotion regulation. The results of the dissertation are thereby embedded in a bigger picture by identifying conditions under which shedding or withholding tears is functional or dysfunctional. Finally, potential implications for everyday life are discussed and the main results will be summarized in a conclusion.

6.1. Limitations and future directions

On the interaction of person-related and situational variables. The impact of situational and person-related variables on the shedding of emotional tears has been examined separately in the present work. Given that human behavior is more adequately explained when situational and person-related variables are considered simultaneously (Bushman & Anderson, 2002; Kanfer & Saslow, 1969), future research should examine the *interaction* of these variables with respect to crying. Specifically, it should be tested whether individual differences on certain personality traits are related to the frequency of crying under certain circumstances. Denissen and Penke's (2008) conceptualization of personality seems especially promising in this regard.

The authors suggest that personality traits can be understood as individual differences in motivational reactions to certain environmental stimuli. In contrast to a purely descriptive view of personality, the authors could demonstrate that a Big 5 structure of personality can also be established when focusing on motivational responses. A sample item from their inventory to assess neuroticism is, “I seldom fear that other people may not like me (reversed coded)”. In comparison, a sample item from Goldberg's et al. (2006) descriptive personality approach is, “I worry about things”. Denissen and Penke (2008, p. 1285) assume that neuroticism can be conceptualized as “differences in the activation of the punishment system when faced with cues of social exclusion”. Considering this perspective on neuroticism and my need-based taxonomy of crying, a stringent hypothesis can be derived: Individuals scoring high on neuroticism cry more often due to frustration of relatedness (i.e., episodes that involve loneliness) than their respective counterparts. Such an interactional perspective of person-related and situational variables might be a promising avenue when it comes to improving our understanding of crying.

Considering alternative crying taxonomies. The taxonomy presented in Chapter 4 is the first categorization system for crying episodes derived from a theoretical basis involving consideration from emotion and motivation theories. Even though the taxonomy is empirically well-supported, it can be argued that the FRC is only one way to categorize emotional crying. If another theoretical perspective is applied, researchers might reveal different categories. If one considers personality psychology, for example, different approaches have led to diverging conceptualizations of personality. While lexical approaches such as the HEXACO model (Ashton & Lee, 2007) identified the factors honesty, emotionality, extraversion, agreeableness, conscientiousness, and openness, the biologically oriented model by Panksepp distinguished seeking, play, care, fear, sadness, and anger (Panksepp, 2004). Even though the models partially overlap (e.g., seeking corresponds with openness), there are also points where they seem incompatible (i.e., there is no equivalent for conscientiousness, Marengo et al., 2021). In the

future it would be exciting to see different competing models of crying, hoping that in the long run the most plausible and parsimonious one with the highest explanatory power will gain general acceptance.

The necessity of a differentiation of crying episodes is out of question, but here I again summarize the most relevant reasons. First, interindividual consequences of shedding emotional tears are dependent of the situational antecedents of crying. As demonstrated in Chapter 4, shedding tears in reaction to a movie differs from crying episodes involving harmony, loneliness, impotence, or overload. Rather than examining affective consequences of crying per se, future studies should consider the situational antecedent when examining the cathartic effect of crying. Second, interpersonal effects of crying seem also to be a function of the situational antecedent of crying. Recent empirical evidence suggests that how competent a crying individual is perceived by observers depends on whether a plausible reason is apparent or not (Wróbel et al., in press). It can be proposed that considering specific situational antecedents of crying (e.g., by drawing on the FRC) has the potential to reveal the interpersonal consequences of crying on a more fine-grained level.

Taking advantage of the fact that crying has a behavioral component. As described in the introduction, one interesting aspect of crying is that it can be observed by others. Even though participants in my empirical work were instructed to reveal information about their behavior (instead of pure introspective self-reports; Baumeister et al., 2007), the potential of analyzing the behavioral level of crying has not been fully exploited. Future work could adapt this idea by examining crying in everyday life from an observer perspective. Given the controversial debate under which circumstances tearful (vs. tearless) individuals are perceived as less competent by others (see Chapter 2 for a review of this debate), an analysis of how crying individuals are perceived by others in naturalistic settings could improve our understanding of interpersonal effects of tears in an ecologically valid way.

Applying a social dilemma perspective on the interpersonal effects on emotional crying. Given that none of my empirical studies contained experimental factors, it seems worthwhile to consider what experimental methods can be used in the future to improve our understanding of crying. One possible option could be social dilemma paradigms (van Lange et al., 2013), which offer the opportunity to map behavior in game theoretic paradigms. Current approaches studying the interpersonal effects of crying mainly captured self-reported intentions to help a tearful (vs. tearless) target (Zickfeld et al., 2021). Social dilemmas would have the appeal that *behavioral* variables could be examined. It could be tested whether crying (vs. non-crying) targets in a prisoner's dilemma are more likely to be responded to with cooperation or defection, or whether crying (vs. non-crying) targets are trusted more or less in a trust game. Moreover, such studies can shed light on repeated interactions with a crying individual. Public goods games could also be used to investigate the interpersonal effects that trigger tears when more than one other person is involved in an interaction. In sum, social dilemmas may offer a completely new playing field in the study of the phenomenon of emotional crying.

Examining the neuronal correlates of human emotional crying. As reviewed in the introduction, most work examining the neuronal correlates of crying stems from single case studies and animal research (Bylsma et al., 2019). Research that focused on physiological correlates such as skin conductance, heart rate, and heart rate variability in human participants revealed somewhat divergent findings. Surprisingly, there is no fMRI study available that investigates the neuronal correlates of human emotional crying. Since crying cannot be induced in every person (Gračanin et al., 2015), actors and actresses who can voluntarily shed tears represent a suitable sample for such a study. It would certainly be exciting to examine to what extent the previous ideas regarding the neuronal basis of crying can be verified.

6.2. Implications for other forms of emotion expression

Crying represents one specific form emotion expression which raises the question of whether insights of the present work can also be applied to other forms of emotion expression. Laughter can be considered as another prominent form of emotion expression, which shows interesting parallels with crying. Laughing is assumed to comprise both intrapersonal effects, like better health and well-being (Gonot-Schoupinsky et al., 2020), and interpersonal effects, such as strengthening social bonds (e.g., Kashdan et al., 2014), or excluding somebody through laughter (Klages & Wirth, 2014). Furthermore, frequency of laughing is associated with personality traits; specifically, extraversion is positively related to laughing frequency (Ruch & Deckers, 1993). In view of these conceptual parallels, it is worth thinking about which considerations regarding crying can be transferred to the phenomenon of laughter. Interestingly, the question of whether there are different forms of laughter seems to be researched with similar intensity as the search for a typology of crying (Cosentino et al., 2016; Mazzocconi et al., 2020; Ruch et al., 2019). A psychological need perspective could also be useful in this context. Thinking about SDT-needs and their satisfaction, the following categories emerge: social laughter (triggered by satisfied relatedness); relief laughter (triggered by satisfied autonomy); superiority laughter (triggered by satisfied competence). Even if this typology of laughter may seem comprehensive at first glance, considering childlike laughter, it becomes apparent that a restriction to SDT-needs is not sufficient in this context. Regarding Young's et al. (2003) idea that *spontaneity/play* represents an independent psychological need might remedy this issue. Laughing through tickling, which is a prototypical example of childlike laughter (Panksepp, 2000), could be subsumed under this additional category, possibly named ‘fooling around’ laughter.

These considerations imply two aspects for future research. First, it is worthwhile to examine whether findings from the domain of crying can be transferred to that of other forms of emotion expression, such as laughing. Second, when proposing alternative need-based

typologies of emotion expressions, considering other psychological needs than relatedness, autonomy and competence seems worthwhile.

6.3. Analyzing the functionality of crying from an emotion regulation perspective

The functionality of shedding emotional tears can be discussed on a more global level when considering the concept of emotion regulation. So far, the focus has been mainly on the phenomenon and the functionality of crying: What is crying (Chapter 1)? What is crying good for (Chapter 2)? Which individuals cry more/less and who feels better after crying (Chapter 3)? What situational antecedents are commonly associated with crying and how do they differ (Chapter 4)? How is crying approached empirically (Chapter 5)? In this section, two additional perspectives are brought into the discussion: First, under what circumstances is crying *dysfunctional*? Second, under what circumstances is *non-crying* (i.e., suppressing emotional tears) dysfunctional, and under what circumstances is it functional? Before discussing these two additional perspectives, emotion regulation will be defined.

To define emotion regulation, it is necessary to differentiate emotions from stress response and moods. In contrast to stress response, emotions cannot only comprise negative valences, but also positive ones. In contrast to moods, emotions are of shorter duration and are mostly triggered by specific events, while moods are long-lasting and more diffuse (Gross, 2015). Put differently, mood is the "pervasive and sustained 'emotional climate'" while emotions are "fluctuating changes in emotional 'weather'" (American Psychiatric Association, 1994, p. 763). Emotion regulation takes place when the goal to influence emotional trajectories is activated (Gross et al., 2011). In line with a hedonic motive, individuals mostly tend to downregulate aversive emotions such as anger, sadness, or anxiety (Gross et al., 2006), while they upregulate pleasant emotions such as joy or happiness (Quoidbach et al., 2010). The process model of emotion regulation suggests five families of emotion regulation strategies, which can be applied consciously or unconsciously: a) situation selection—taking actions that

make it less (or more) likely to be confronted with a situation that triggers emotions, e.g., avoid an aggressive neighbor or watching a touching movie; b) situation modification—actively modifying the emotional impact of a situation, e.g., suggesting a change of topic in an argument that has become bogged down; c) attentional deployment—redirecting one's attention aiming to regulate one's emotional response, e.g., thinking about the upcoming weekend trip during a boring conversation, d) cognitive change—adjusting one's emotional response by reappraising, e.g., "Peter's anger has nothing to do with me, but with his insecurity"; e) response modification—regulating aspects of a full-blown emotion episode, e.g., dampen sadness through drugs, food, physical exercise, or expressive suppression.

Looking closely at these examples makes clear that emotion regulation is not functional or dysfunctional voluntarily (John & Gross, 2004); rather, it depends on the chosen strategy and the given circumstances. Sometimes the unfolding primary (i.e., unregulated) emotion is associated with more advantages than disadvantages, and at other times, emotion regulation fares better. Applying this reasoning to the expression vs. down-regulation[15] of emotional crying, four different cases can be identified, including: dysfunctional aspects of crying (i.e., expression), dysfunctional aspects of non-crying (i.e., down-regulation), functional aspects of non-crying, and functional aspects of crying. An overview of these cases is presented in Table 14.

Table 14. *When (non-)crying is (dys-)functional.*

	crying	non-crying
dysfunctional	interpersonal: -when it damages one's reputation -when it increases physical threat intrapersonal: -when it leads to an emotional downward spiral	interpersonal: -when it leads to less liking by others -when it leads to fewer social support intrapersonal:

[15] Emotional upregulation leading to crying will not be considered in this context.

		-when it leads to worse memory -when it leads to worse well-being
functional	interpersonal: -when others react in a prosocial way -(when it appeases others, e.g., an aggressor) intrapersonal: -when it leads to emotional relief (catharsis)	interpersonal: -when it avoids damage to reputation -when it avoids physical threat intrapersonal: -when it avoids an emotional downward spiral

Dysfunctional aspects of crying. A qualitative study by Elsbach and Bechky (2018) suggests that crying is dysfunctional in many work-related situations. Female workers were negatively evaluated by coworkers when crying was triggered through ordinary work challenges, occurred during meetings, or disrupted others from work. Only if crying occurred in the context of extraordinary demands was it perceived as more acceptable. This aligns with Bylsma's et al. (2011) findings that affect after crying is more negative when many (vs. one) observers are present. The authors assumed that crying in front of a larger audience (e.g., at work) might involve strong aversive social emotions such as shame and embarrassment. Findings from Wróbel et al. (in press) also suggest that the presence of tears could lead to reduced competence ascriptions from observers when crying is regarded as inadequate or when the crying individual is perceived as helpless. In these cases, crying can be interpreted as harming one's reputation. A finding by Fischer and colleagues (2013) also fits in with this. With reference to the role congruency theory, the authors demonstrated that crying men are evaluated more negatively at work than crying women.

Unfortunately, crying sometimes also involves negative physical consequences for the crying individual. Ullman and Knight (1993) analyzed court testimonies and police reports involving cases in which women had been victims of sexual assaults. While massive physical resistance to the attacker (e.g., kicking him or using a weapon against the perpetrator) lowered

the probability of being raped, it increased the likelihood of being physically injured by the attacker. Crying and pleading did not decrease the likelihood of being raped. In contrast, when the assault took place indoors (vs. outdoors), crying was associated with higher levels of injuries for the victim.

In the context of aversive interpersonal effects of crying, infant crying can hardly be left out. Research that focused on the so-called shaken baby syndrome (SBS), a condition which is characterized by nonaccidental head injuries in infants often caused by their caregivers (Duhaime et al., 1998), revealed an alarming association with crying. The daily duration of infant crying increases at age 2-3 weeks, reaches its peak at 6 weeks of age (circa 140 minutes a day), then drops back to a lower and more stable level by 6 months of age (Lee et al., 2007). The age distribution of babies diagnosed with SBS follows a similar pattern. The youngest affected children are about 2–3 weeks old, the peak is somewhat delayed and is reached between 9 and 12 weeks of age, from which the prevalence decreases again. Regarding the delay of the peak, there is strong reason to believe that impacted infants undergo more than one episode of shaking and/or abuse before they have contact with the health care system (Lee et al., 2007). In sum, the parallel pattern of the curves is remarkable and suggests that crying is a potent trigger of SBS, which is also supported by analyses of infant maltreatment deaths (Adinkrah, 2003).

Intrapersonal factors have also been associated with negative effects of crying. Individuals characterized by anxiety and anhedonia were more likely to feel worse after crying (Rottenberg et al., 2008b). The same applies to individuals scoring high (vs. low) on disintegration (see Chapter 3). When crying leads to such an emotional downward spiral, it could be interpreted as dysfunctional.

Dysfunctional aspects of non-crying. The suppression of emotions has been related to costly side effects, such as worse memory for the respective episode (Richards & Gross, 1999, 2000), lesser liking by interaction partners (e.g., Ben-Naim et al., 2013), and worse well-being

(Gross & John, 2003; Nezlek & Kuppens, 2008). Although these effects have not been tested for suppressing emotional tears, it is plausible to assume that they are transferable to crying. If drug use, intensive food consumption, excessive working, or excessive exercising is used to distract oneself from emotions that have the potential to elicit tears, non-crying may be associated with respective negative long-term consequences, like the development of an addiction disorder.

Functional aspects of non-crying. The functional aspects of non-crying arise as counterparts of the dysfunctional aspects of crying. Suppressing tears could prove beneficial when it averts physical harm (Ullman & Knight, 1993), defends against reputation damage (Fischer et al., 2013; Wróbel et al., in press), and avoids an emotional downward spiral (Rottenberg et al., 2008b). The ability to delay the shedding of tears could play a decisive role in this context. If individuals manage not to cry in a triggering situation where showing tears would come at a high cost (e.g., at work) and postpone it to a more appropriate situation (e.g., when talking to one's partner in the evening), it stands to reason that temporarily suppressing tears may be functional. To the best of my knowledge, there are so far no empirical studies on this idea.

Functional aspects of crying. The diary study of Bylsma et al. (2011) suggests that crying is under certain circumstances associated with affective benefits. Rather trivial is the finding that crying is perceived as beneficial when it improves the triggering situation (see also Bylsma et al., 2008). More interestingly, higher crying intensity was positively related to better affect after crying. The authors speculated that more intense crying might evoke more social support by others, which in turn improved the affective state of the crying individual. This fits with another finding of this study, namely that crying is affect-enhancing when one other person (vs. no/many person/s) is present. Thus, inter- and intrapersonal effects of crying may not be separable, but they could be interdependent: crying is cathartic, but only if not too few or too

many others are present (see also Gračanin et al., 2018). As summarized in Chapter 2, it is well established that observers report an increased willingness to help when a person is crying (vs. not crying; e.g., Zickfeld et al, 2021). If one also assumes that this help is actually provided (and is desired by the target), this would be a case in which the shedding of tears can be considered as functional. As outlined in Chapter 3, certain person variables are associated with better well-being after crying, namely honesty, extraversion, and agreeableness.

In summary, a consideration of an emotion-regulatory perspective in the study of the phenomenon of crying holds great potential. First, this approach underlines how context-dependent the effects of shedding tears are. Under some circumstances, the crying person feels emotionally relieved and receives support from others; under other conditions, tears endanger emotional balance, reputation, or physical integrity. Second, the concept of emotion regulation draws attention to a phenomenon that has so far received too little attention, that is, the suppression and delay of emotional tears. Again, the effects of (temporarily) suppressing tears are probably highly context-specific. It can be assumed that when tears are suppressed, the benefits sometimes outweigh the costs (e.g., when harm to one's reputation is averted); on the other hand, there is evidence suggesting that repeated suppression of emotional states may come at a high cost (e.g., difficulties in social interactions). Accordingly, in future research projects, emotional crying and its (temporary) suppression should be investigated under a wide variety of contextual conditions. For this endeavor, Ambulatory Assessment seems particularly suitable since it allows analysis of various situational antecedents and personal boundary conditions and their (interaction-)effects on crying.

6.4. Potential implications for everyday life

The empirical insights gained from this dissertation can potentially be transferred to everyday life as follows. When we encounter a person who is crying, the FRC could potentially serve as a heuristic to understand more quickly what a person is crying about. A quicker

understanding of the background of crying could facilitate an appropriate response to tears. If tears are due to frustrated relatedness, responses involving closeness and warmth seem appropriate to comfort a crying person. If tears are due to frustrated autonomy, drawing attention to areas of life where autonomy is still present may provide solace in such situations. In sum, the FRC could help make interpersonal relationships more efficient and successful in terms of satisfying basic psychological needs.

The results concerning personality traits can possibly be applied as follows. When we encounter a crying person who is highly emotional (in terms of a personality trait), we should try to help that person, possibly by offering support. On average, highly emotional individuals experience less affective relief from crying than more emotionally stable persons. For highly extraverted individuals, this support seems likely to be somewhat less urgent, as they are more prone to experience crying as cathartic compared to less extraverted individuals.

6.5. Conclusion

In the present work, the ABC of emotional crying was analyzed, by shedding light on its situational antecedents, person-related boundary conditions, and its inter- and intrapersonal consequences. Regarding the consequences of crying, it can be concluded that the effects of crying are highly context-dependent. While crying is cathartic under some circumstances, it poses immense costs in other situations. Future research should therefore consider various situational antecedents and person-related boundary conditions as well as the suppression of emotional tears, when analyzing the effects of crying.

Regarding its person-related boundary conditions, previously inconsistent relations among personality traits, crying frequency, and affect after crying could be clarified. A well-powered and pre-registered study revealed, for example, that extraversion was related to reduced crying frequency and better affect after crying. Reviewing and re-analyzing work that

elaborated on the relation between tears and depression suggested that depressive symptoms can be associated with increased weepiness or an inability to shed emotional tears.

Regarding the situational antecedents of crying, it was proposed that crying is triggered in situations that have the potential to affect psychological needs, and empirical support was found for that claim. Based on this consideration, the first theory-derived taxonomy to categorize different types of crying according to its trigger was developed. This taxonomy is innovative because it relates appraisal-theoretical considerations to assumptions about psychological needs in a novel way, thus allowing for a theory-based distinction of crying episodes.

As illustrated by the quote from Jonathan Safran Foer's novel *Extremely Loud and Incredibly Close*, crying is a complex and fascinating phenomenon of human emotion expression: Humans cry in emotionally charged situations and these situations can differ greatly, for example, if they involve tears of joy or sadness. Crying regulates social interactions, it seems to be associated with catharsis under certain circumstances and there are individual differences in how often people cry and how they feel afterwards. In summary, my work on the ABC of crying contributes to a much better understanding of the phenomenon of shedding emotional tears and human functioning in general.

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8. APPENDIX

Appendix A: Supplemental Material Chapter 3 (Barthelmäs & Keller, 2021)

Appendix B: Supplemental Material Chapter 4 (Barthelmäs et al., 2022)

Appendix C: Preregistration Study 3 (Barthelmäs et al., 2022)

Appendix A

Table A1. *Zero-order correlations between all scales of the study (Spearman correlation coefficients)*

		Correlations (*p*-values)										
	M (*SD*)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Crying frequency (CF)	**1.84**	**1.000**	**0.007**	**0.053**	**0.052**	**0.413**	**-0.148**	**-0.097**	**-0.048**	**0.044**	**0.150**	**-0.218**
	(3.17)	(<.001)	(.857)	(.188)	(.195)	(<.001)	(<.001)	(.016)	(.228)	(.275)	(<.001)	(<.001)
(2) Crying frequency	**1.48**	1.000	**0.008**	**0.053**	**0.052**	**0.413**	**-0.147**	**-0.098**	**-0.049**	**0.044**	**0.151**	**-0.218**
(winsorized[a])	**(1.80)**		(.851)	(.190)	(.196)	(<.001)	(<.001)	(.015)	(.226)	(.274)	(<.000)	(<.001)
(3) Affect-change	5.65		1.000	0.555	0.179	-0.014	0.188	0.153	0.068	0.103	-0.095	0.187
	(1.67)			(<.000)	(<.001)	(.725)	(<.001)	(<.001)	(.092)	(.010)	(.018)	(<.001)
(4) Arousal-change	6.36			1.000	0.165	-0.026	0.091	0.161	0.087	0.169	-0.076	0.085
	(1.72)				(<.001)	(.516)	(.024)	(<.001)	(.030)	(<.001)	(.058)	(.035)
(5) Honesty/Humility	4.79				1.000	0.004	0.017	0.224	0.302	0.274	-0.366	0.066
	(0.92)					(.913)	(.671)	(<.001)	(<.001)	(<.001)	(<.001)	(.099)
(6) Emotionality	4.11					1.000	-0.248	-0.198	0.014	0.029	0.126	-0.265
	(0.91)						(<.001)	(<.001)	(.719)	(.465)	(.002)	(<.001)
(7) Extraversion	4.04						1.000	0.299	0.094	0.070	-0.330	0.579
	(0.92)							(<.001)	(.020)	(.080)	(<.001)	(.001)
(8) Agreeableness	4.25							1.000	0.015	0.101	-0.185	0.268
	(0.71)								(.712)	(.012)	(<.001)	(<.001)
(9) Conscientiousness	4.84								1.000	0.224	-0.442	0.137
	(0.81)									(<.001)	(<.001)	(.001)
(10) Openness	4.53									1.000	-0.124	0.056
	(0.91)										(.002)	(.166)
(11) Disintegration	2.65										1.000	-0.369
	(1.07)											(<.001)
(12) WHO-5	4.17											1.000
	(1.30)											
(13) SWLS	4.19											
	(1.38)											

Notes. [a] the upper 5% of the CF values were set equal to the value corresponding the 95 percentile ($range_{CF\ winsorized}$ = 0 – 6; $range_{CF}$ = 0 - 21)

Appendix B

List of tables

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Table S1 – all studies. Interrater reliabilities (overall agreement and agreement on each category).

	Pilot Study	Validity Check	Study 3	Study 4
	κ	κ	κ	κ
overall agreement	.90	.87	.87	.83
loneliness	.91	.94	.88	.79
impotence	.89	.94	.87	.76
overload	.89	.73	.76	.82
harmony	.63	.85	.84	.68
media	.95	.83	.94	.93

Notes. κ = Fleiss' Kappa. We also calculated Light's Kappa for the overall agreement, as it more appropriate in the present case. Results were identical for Light's and Fleiss' Kappa.

Additional information – Pilot Study.

Additional measures. We instructed participants to rate their crying episode regarding the 8 DIAMONDS and crying characteristics (i.e., duration and intensity) and to fill in the HEXACO Personality Inventory (Ashton & Lee, 2007).

Sample size. We aimed to compare crying and non-crying episodes in an exploratory analysis. We decided to refer to already published data on non-crying episodes. This approach allowed us to keep the Pilot Study short and thus cost-effective. We identified a recent article by Horstmann et al. (2020, Study 2) in which everyday episodes were rated with regard to situation characteristics in an experience sampling study. We collected data on crying episodes and aimed to keep the sample composition and size comparable to that of Horstmann and colleagues (Study 2: N = 274, M_{age} = 24.22, SD_{age} = 6.35, $range_{age}$ = 17 – 53, 231 women, 41 men, 20 not specified, 90.51% students).

Table S2 – Study 3. *FRC Questionnaire.*

German	English
Anweisung: Auf dieser Seite sehen Sie einige Gründe warum Menschen weinen. Welcher dieser Gründe beschreibt den Auslöser Ihres Weinens am besten?	Instruction: On this page you see some reasons why people cry. Which of these reasons best describes the trigger of your crying?
1) Ich habe mich mit jemandem gestritten. 2) Ich habe jemanden vermisst. 3) Ich habe mich von jemandem ausgeschlossen gefühlt.	1) I had a fight with someone. 2) I missed someone. 3) I felt excluded from someone. 4) The death of someone affected me. 5) The illness of someone affected me.

4) Der Tod von jemandem hat mich betroffen gemacht. 5) Die Erkrankung von jemandem hat mich betroffen gemacht. 6) Das Leid von jemandem hat mich betroffen gemacht. 7) Ich war mit einer Aufgabe überfordert. 8) Ich habe mir Selbstvorwürfe gemacht. 9) Ich habe mir Sorgen bezüglich der Zukunft gemacht. 10) Jemand hat mir etwas sehr Schönes gesagt oder für mich getan. 11) Ich habe etwas sehr Schönes / Bewegendes erlebt oder beobachtet. 12) Ich habe mich mit jemandem sehr verbunden gefühlt. 13) Ich habe eine rührende Szene in einem Film/ einer Serie gesehen. 14) Ich habe einen rührenden Videoclip gesehen. 15) Ein anderer Medieninhalt hat mich zum Weinen gebracht (Lied, Podcast, Nachrichten, Buch, Anzeige, Werbung, Videospiel, Post in sozialem Netzwerk, etc.) 16) anderer Grund … (offenes Antwortformat)	6) The suffering of someone affected me. 7) I was overwhelmed with a task. 8) I blamed myself. 9) I was worried about the future. 10) Someone said something very nice to me or did something nice for me. 11) I experienced or observed something very beautiful / moving. 12) I felt very connected to someone. 13) I saw a touching scene in a movie/series. 14) I saw a touching videoclip. 15) Another piece of media content made me cry (song, podcast, news, book, advertisement, commercial, video game, social network post, etc.). 16) other reason … (open response)
Zuordnung/classification: Loneliness: 1, 2, 3 Impotence: 4, 5, 6 Overload: 7, 8, 9 Harmony: 10, 11, 12 Media: 13, 14, 15	

Table S3 – Study 3. *Likelihood Ratio Tests – multinomial regression – Emotions - FRC.*

	-2 Log Likelihood of Reduced Model	χ^2	*df*	*p*
happy	1546.22	99.56	4	<.001
inspired	-	-	-	-
enthusiastic	-	-	-	-
proud	1454.90	8.24	4	0.083
excited	1452.64	5.98	4	0.201
sad	-	-	-	-
afraid	1449.98	3.33	4	0.505
anxious	1468.06	21.40	4	<.001
ashamed	1466.26	19.60	4	0.001
angry	1489.59	42.94	4	<.001
intercept	1596.21	149.55	4	<.001

Notes. Model fit information: $\chi^2(28) = 486.93$ $p < .001$; Negelkerke's $R^2 = .54$

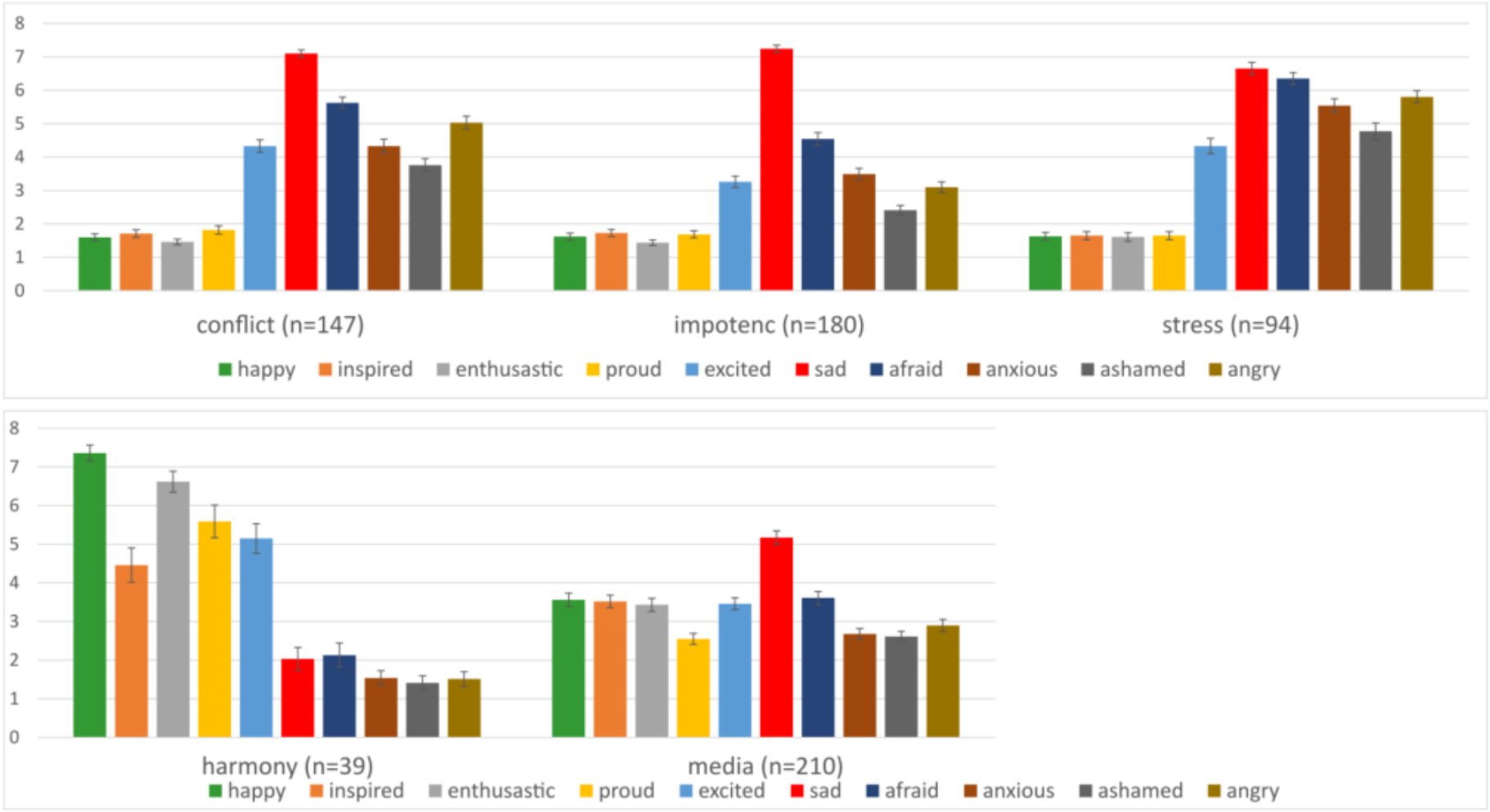

Figure S1 – Study 3. Emotion intensity for FRC. Error-bars denote +/- 1 SE (Barthelmäs et al., 2022).

Table S4 – Study 3. *Parameter estimates for multinomial regression – Emotions - FRC.*

	B	*SE*	*Wald*	*df*	*p*	*exp(B)*	*95% CI for exp(B)*	
							Lower Bound	*Upper Bound*
loneliness								
happy	-0.50	0.11	22.46	1	<.001	0.61	0.49	0.75
inspired								
enthusiastic								
proud	0.07	0.10	0.58	1	0.446	1.08	0.89	1.30
excited	0.10	0.06	2.44	1	0.118	1.10	0.98	1.24
sad								
afraid	0.08	0.07	1.50	1	0.220	1.09	0.95	1.24
anxious	0.16	0.07	5.10	1	0.024	1.17	1.02	1.34
ashamed	0.03	0.06	0.20	1	0.659	1.03	0.91	1.17
angry	0.17	0.06	7.57	1	0.006	1.18	1.05	1.34
intercept	-1.44	0.40	13.06	1	<.001		-1.44	0.40
impotence								
happy	-0.53	0.09	38.17	1	<.001	0.59	0.50	0.70
inspired								
enthusiastic								
proud	0.07	0.09	0.69	1	0.406	1.08	0.90	1.28
excited	0.02	0.06	0.13	1	0.720	1.02	0.91	1.14
sad								
afraid	0.03	0.06	0.24	1	0.623	1.03	0.91	1.16
anxious	0.18	0.07	7.10	1	0.008	1.20	1.05	1.37
ashamed	-0.14	0.07	4.84	1	0.028	0.87	0.76	0.98
angry	-0.10	0.06	3.10	1	0.078	0.90	0.80	1.01
intercept	0.91	0.31	8.37	1	0.004		0.91	0.31

Table S4 (continued)

							95% CI for exp(B)	
	B	*SE*	*Wald*	*df*	*p*	*exp(B)*	*Lower Bound*	*Upper Bound*
overload								
happy	-0.29	0.13	4.79	1	0.029	0.75	0.58	0.97
inspired								
enthusiastic								
proud	-0.10	0.13	0.61	1	0.434	0.90	0.70	1.17
excited	0.01	0.07	0.01	1	0.922	1.01	0.87	1.16
sad								
afraid	0.12	0.09	1.68	1	0.194	1.13	0.94	1.35
anxious	0.35	0.08	17.60	1	<.001	1.42	1.20	1.67
ashamed	0.14	0.07	3.68	1	0.055	1.15	1.00	1.32
angry	0.31	0.08	15.62	1	<.001	1.36	1.17	1.58
intercept	-3.92	0.63	38.54	1	<.001		-3.92	0.63
harmony								
happy	0.81	0.21	14.82	1	<.001	2.25	1.49	3.39
inspired								
enthusiastic								
proud	0.23	0.10	5.65	1	0.017	1.25	1.04	1.51
excited	0.17	0.10	2.70	1	0.100	1.18	0.97	1.44
sad								
afraid	0.17	0.16	1.14	1	0.287	1.19	0.87	1.62
anxious	-0.27	0.23	1.37	1	0.241	0.76	0.49	1.20
ashamed	-0.33	0.27	1.53	1	0.217	0.72	0.42	1.21
angry	0.25	0.23	1.20	1	0.273	1.28	0.82	2.01
intercept	-7.93	1.66	22.66	1	<.001		-7.93	1.66

Notes. SE = standard error; *CI* = Confidence Interval.

Additional analyses - Study 3.

Language analysis. We used the r-package 'udpipe' (Straka & Straková, 2017) to examine the wording used to describe crying episodes. We counted the most frequent nouns, verbs and adjectives used in each FRC category.

Girlfriend/friend, conflict and partner were the most frequently used nouns for loneliness. Death, mother and father were the most frequently used nouns for impotence. Situation, stress and work were the most frequently used nouns for overload. Joy, time and girlfriend/friend were the most frequently used nouns for harmony. Movie, video and scene were the most frequently used nouns for media. Detailed results are depicted in Table S5.

The linguistic differences found between the FRC could serve as starting point to train a machine-learning algorithm. Future studies that demonstrate successful categorization of crying reports through an algorithm would provide further evidence in favor of the validity of the FRC.

Table S5 – Study 3. *Frequency of words used to describe crying episode. We listed the five most frequently used nouns, verbs and adjectives per category (frequency is given in parentheses).*

	nouns	*verbs*	*adjectives*
loneliness			
	girlfriend/friend (27)	cry (48)	sad (15)
	conflict (20)	have (34)	last (8)
	partner (16)	argue (28)	hard (8)
	boyfriend/friend (15)	feel (19)	good (5)
	relationship (10)	miss (13)	long (5)
impotence			
	death (37)	die (48)	deceased (21)
	mother (23)	learn (36)	sad (14)
	father (22)	think (31)	good (10)
	funeral (12)	cry (29)	other (5)
	dog (12)	make (8)	close (5)

Table S5 (continued)

overload			
	situation (19)	have (28)	overwhelmed (8)
	stress (16)	cry (17)	current (5)
	work (16)	feel (12)	sad (4)
	future (8)	overwhelmed (5)	strong (4)
	tears (6)	make (7)	frequent (3)
harmony			
	joy (8)	cry (11)	nice (5)
	time (5)	be glad (5)	long (3)
	girlfriend/ friend (4)	make (4)	good (3)
	son (4)	get (2)	better (2)
	moment (4)	go (2)	other (2)
media			
	movie (109)	watch (148)	touching (54)
	video (28)	have (34)	sad (30)
	scene (28)	cry (25)	emotional (21)
	serial (17)	touched (19)	moist (10)
	eyes (16)	hear (18)	easy (6)

Note. Straka, M., & Straková, J., (2017). Tokenizing, POS Tagging, Lemmatizing and Parsing UD 2.0 with UDPipe. In *Proceedings of the CoNLL 2017 Shared Task: Multilingual Parsing from Raw Text to Universal Dependencies* (pp 88– 99). Association for Computational Linguistics. http://dx.doi.org/10.18653/v1/K17-3009

Involved person/ animal. For exploratory analyses we asked participants to specify whether another person or animal was involved in the crying episode, or not. If another person or animal was involved in crying, we asked whether the other creature was personally known and (if yes) in which category it fell (i.e., family, friends, work or pet).

We found considerable differences regarding whether a person/animal was involved in crying. For example, pets were never involved in overload- and loneliness-related crying. So, pets seem to be involved in emotional distress less likely than our fellow humans. Although of a more qualitative nature, these findings speak in favor of our taxonomy.

FRC differed whether another person or animal was involved in the crying episode, $\chi^2(4) = 120.22$, $p < .001$ (Table S6). In the majority of cases, another creature was involved for loneliness (84%), impotence (78%) and harmony (90%). Another person was less likely

involved for overload (39%) and media (41%). FRC also differed whether the creature involved was personally known or not, $\chi^2(4) = 265.64$, $p < .001$ (Table S7). In most cases (> 89%), the involved person or animal was personally known. Only in media, the involved creature was typically not personally known. Across all reasons, family members were most often involved in crying. However, FRC also differed regarding the type of creature involved in crying, $\chi^2(12) = 50.55$, $p < .001$ (Table S8). The prevalence for work-related persons involved in crying was highest for overload (27%) and low (< 10%) for all other categories. Friends were somewhat more involved in loneliness (18%), impotence (16%) and harmony (22%) than in overload (6%) and media (7%). Pets were never involved in loneliness (0%) and overload (0%) but in impotence (14%) and harmony (9%).

Table S6 – Study 3. *Percentages of cases when other person/ animal was involved in the crying episode.*

	loneliness (n=147)	impotence (n=180)	overload (n=94)	harmony (n=39)	media (n=210)	total (n=670)
person/ animal involved	83.67%	77.77%	39.36%	89.74%	41.43%	66.40%
no person/ animal involved	16.33%	22.23%	60.64%	10.26%	58.57%	33.60%

Table S7 – Study 3. *Percentages of cases when person/ animal involved in crying was personally known.*

	loneliness (n=123)	impotence (n= 140)	overload (n=37)	harmony (n=35)	media (n=87)	total (n=422)
personally known	97.56%	96.43%	89.19%	91.43%	16.09%	78.14%
not personally known	2.44%	3.57%	10.81%	8.57%	83.91%	21.86%

Table S8 – Study 3. *Type of person/animal involved in crying.*

	loneliness (n = 120)	impotence (n = 135)	overload (n = 33)	harmony (n = 32)	media (n = 14)	total (n=334)
family	77.50%	66.67%	66.67%	59.38%	85.72%	
friends	17.50%	15.56%	6.06%	21.88%	7.14%	

pets	0.00%	14.07%	0.00%	9.37%	0.00%
work	5.00%	3.70%	27.27%	9.37%	7.14%

Differences between crying and non-crying episodes. To compare crying and non-crying episodes, we instructed participants to describe one non-crying episode of the previous day. They were randomly assigned to report on an episode at 10:00, 12:00, 14:00, 16:00, 18:00, 20:00, or 22:00. After reconstructing the non-crying episode, participants were instructed to rate it regarding the 8 DIAMONDS, need frustration/satisfaction and emotion intensity.

8 DIAMONDS. A logistic regression revealed that six of the 8 DIAMONDS differentiated between crying- and non-crying episodes, $\chi^2(8) = 689.45$, $p < .001$ (Table S9; Figure S2). An increase in intellect, adversity, negativity and deception by one unit each, increased the relative probability that the episode was a crying (compared to non-crying) episode by 12%, 13%, 29% and 18%, respectively. An increase in duty and positivity by one unit each, decreased the relative probability for a crying episode by 35% and 26%.

Table S9 – Study 3. *Regressing 8 DIAMONDS on episode-type (1 = crying; 0 = non-crying).*

					95% CI for *exp(B)*	
	B	*SE*	Wald	*p*	*exp(B)*	*lower*	*upper*
Constant	0.74	0.22	10.89	.001			
duty	-0.43	0.03	169.01	< .001	0.65	0.61	0.69
intellect	0.12	0.04	10.71	.001	1.12	1.05	1.20
adversity	0.12	0.06	4.36	0.37	1.13	1.01	1.26
mating	0.06	0.03	2.98	0.084	1.06	0.99	1.13
positivity	-0.30	0.03	87.31	< .001	0.74	0.69	0.79
negativity	0.26	0.04	45.07	< .001	1.29	1.20	1.39
deception	0.16	0.06	7.45	.006	1.18	1.05	1.33
sociality	-0.03	0.03	0.85	.357	0.97	0.92	1.03

Notes. Nagelkerke's $R^2 = .51$, $f^2 = 1.04$

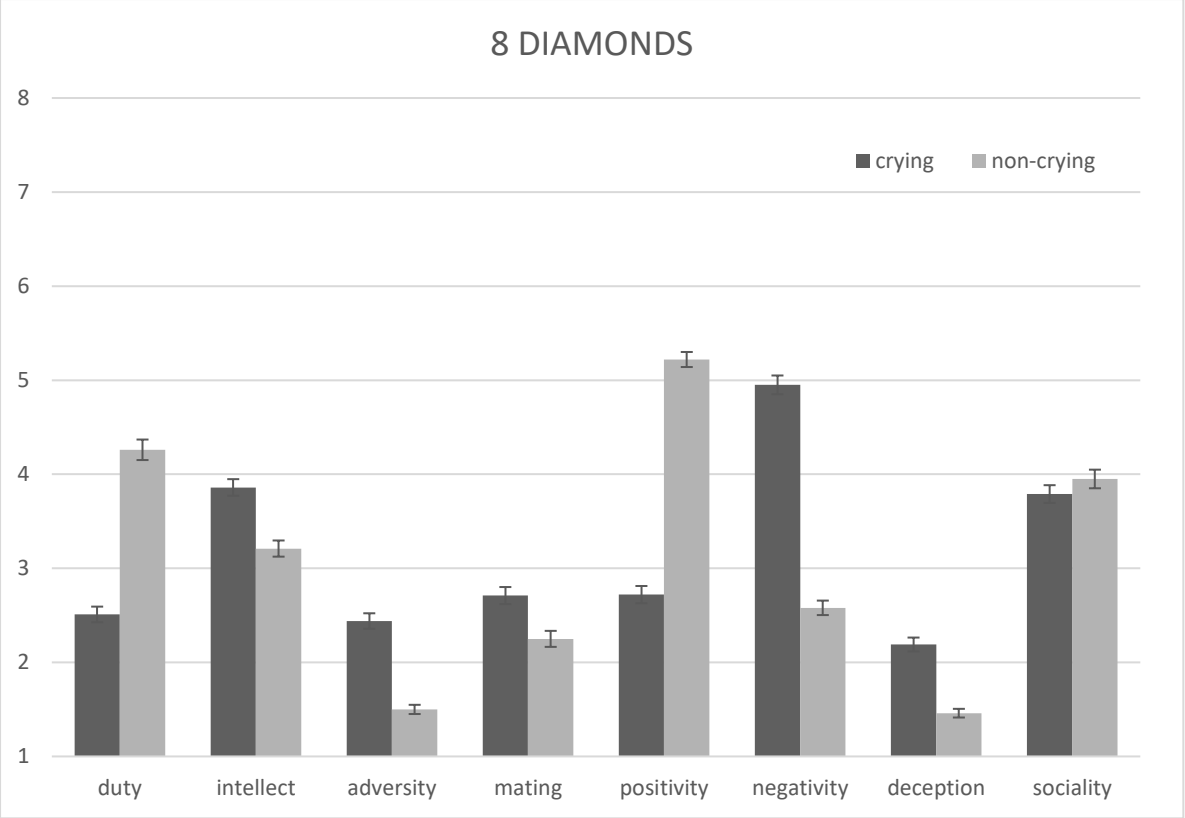

Figure S2 – Study 3. 8 DIAMONDS ratings for crying and non-crying situations. Error-bars denote +/- 1 SE (Barthelmäs et al., 2022).

Emotion Intensity. Due to high correlation among the MEQ-items we omitted sad (r = .67 with afraid), enthusiastic (r = . 81 with happy), inspired (r = .64 with happy) and anxious (r = .74 with afraid) from the regression analysis. The logistic regression revealed that five of the six remaining emotions differentiated between crying- and non-crying episodes, $\chi^2(6) = 446.33$, $p < .001$ (Table S10; Figure S3). An increase in excited, afraid and angry by one unit each, increased the relative probability that the episode was a crying (compared to non-crying) episode by 19%, 14% and 11%, respectively. An increase in happy and proud by one unit each, decreased the relative probability for crying episode by 20% and 16%.

Need frustration/ satisfaction. The logistic regression revealed that four of the six need measures differentiated between crying- and non-crying episodes, $\chi^2(6) = 439.16$, $p < .001$ (Table S11; Figure S4). An increase in relatedness frustration and relatedness satisfaction by one unit each, increased the relative probability that the episode was a crying (compared to

non-crying) episode by 40% and 35%, respectively. An increase in competence satisfaction and autonomy satisfaction by one unit each, decreased the relative probability for crying episode by 30% and 23%.

Table S10 – Study 3. *Regressing emotions on episode-type (1 = crying; 0 = non-crying).*

						95% CI for *exp(B)*	
	B	*SE*	Wald	*p*	*exp(B)*	*lower*	*upper*
Constant	-0.24	0.18	1.76	0.185			
happy	-0.22	0.04	35.48	< .001	0.80	0.75	0.86
proud	-0.18	0.04	21.01	< .001	0.84	0.77	0.90
excited	0.18	0.03	25.93	< .001	1.19	1.12	1.28
afraid	0.13	0.03	14.54	< .001	1.14	1.07	1.22
ashamed	0.08	0.04	3.24	0.072	1.08	0.99	1.17
angry	0.11	0.04	7.37	0.007	1.11	1.03	1.20

Notes. Nagelkerke's $R^2 = .36$, $f^2 = 0.56$

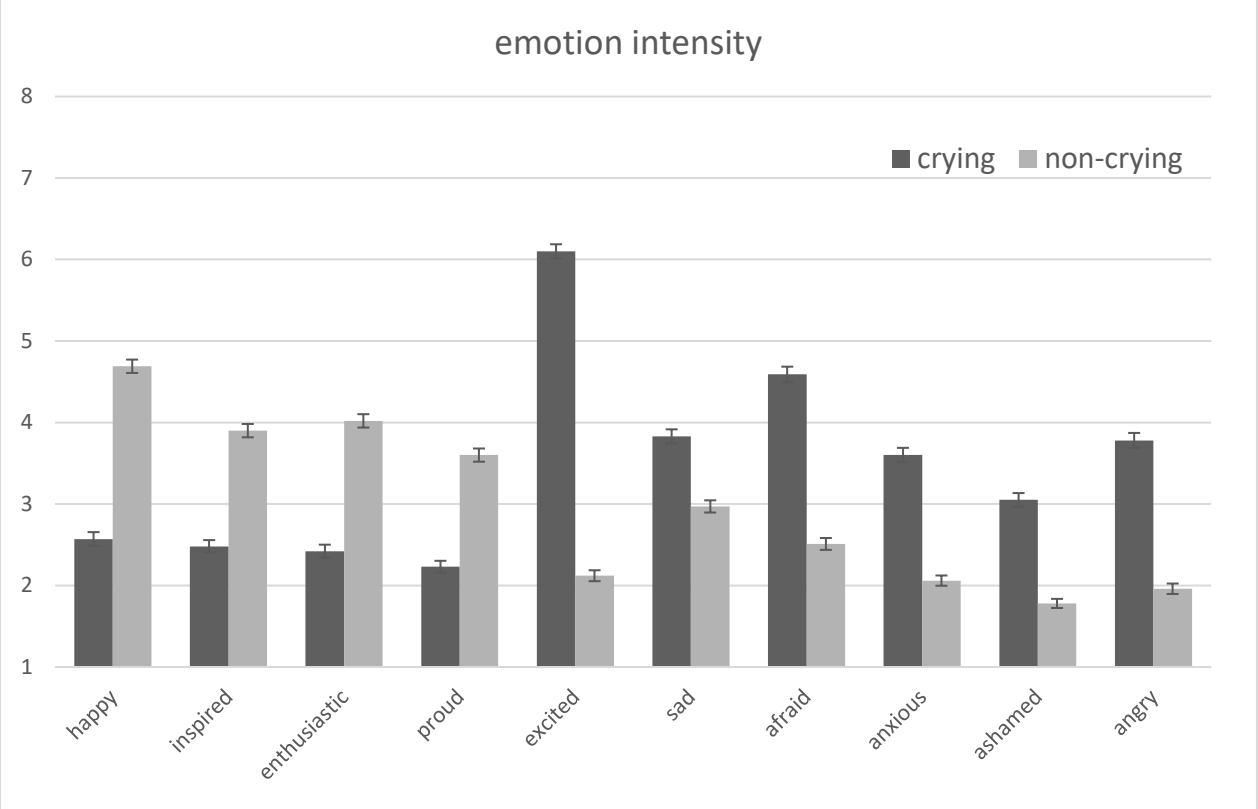

Figure S3 – Study 3. Emotion intensity ratings for crying and non-crying situations. Error-bars denote +/- 1 SE (Barthelmäs et al., 2022).

Table S11 – Study 3. *Regressing needs on episode-type (1 = crying; 0 = non-crying).*

						95% CI for *exp(B)*	
	B	*SE*	Wald	*p*	*exp(B)*	*lower*	*upper*
Constant	0.60	0.20	8.78	.003			
competence frustration	0.01	0.05	0.02	0.887	1.01	0.92	1.10
competence satisfaction	-0.35	0.04	78.55	<.001	0.70	0.65	0.76
autonomy frustration	-0.02	0.04	0.30	0.586	0.98	0.90	1.06
autonomy satisfaction	-0.24	0.04	32.82	<.001	0.78	0.72	0.85
relatedness frustration	0.33	0.05	52.21	<.001	1.40	1.27	1.53
relatedness satisfaction	0.30	0.03	89.54	<.001	1.35	1.27	1.43

Notes. Nagelkerke's $R^2 = .35$, $f^2 = 0.54$

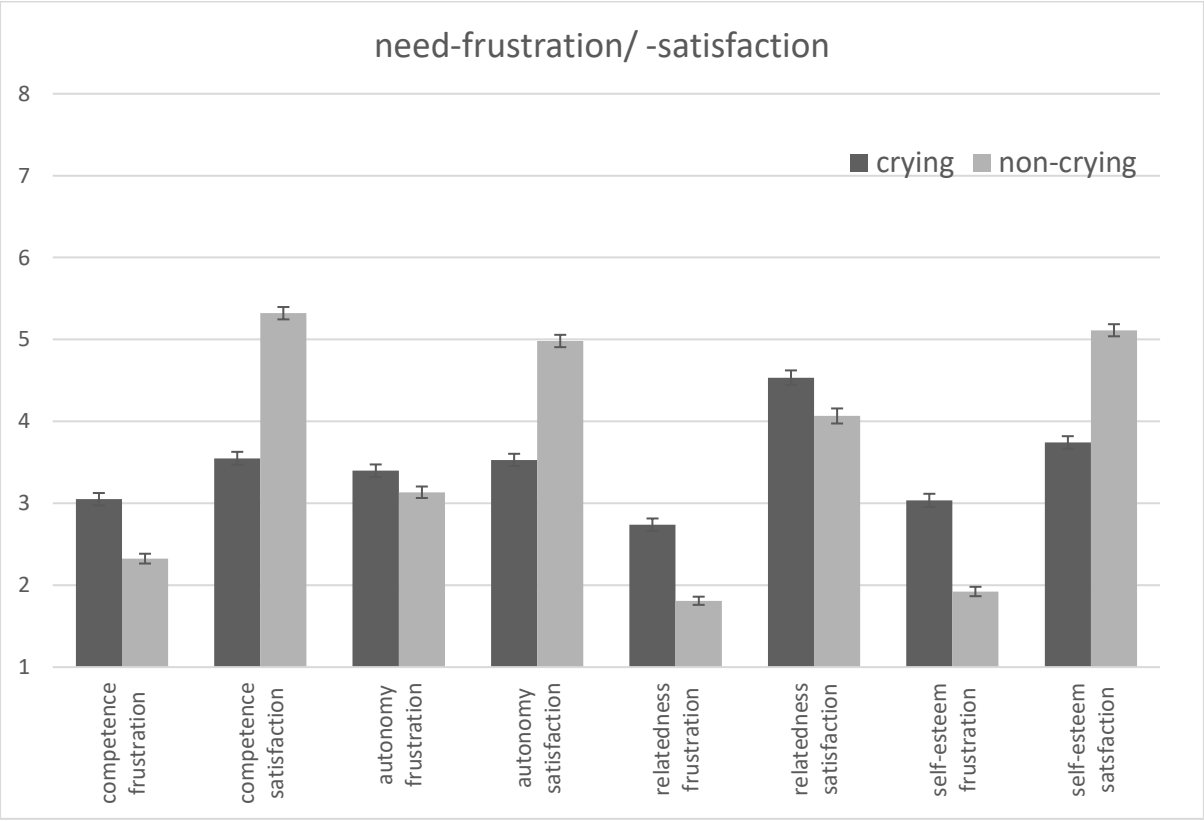

Figure S4 – Study 3. Need frustration/satisfaction ratings for crying and non-crying situations. Error-bars denote +/- 1 SE (Barthelmäs et al., 2022).

Table S12 – Study 4. *List of all measures of measures assessed in Study 2*

Trait measures
HEXACO Personality Inventory-Revised (Ashton & Lee, 2007)
Distress Disclosure Index (Kahn & Hessling, 2001)
Beliefs about Crying Scale – subscale: helpful (Sharman et al., 2019b)
Satisfaction with Life Scale (Diener et al., 1985)
WHO-5 Well-Being Index (Topp et al., 2015)
Experiences in Close Relationships–Revised Scale (Fraley et al., 2000)
State measures
Self-Assessment Manikins – valence and arousal[a] (Bradley & Lang, 1994)
Inclusion of the Other in the Self Scale[b,c] (Gächter et al., 2015)
Crying Characteristics[b] (Becht & Vingerhoets. 2002)
S8-I - Situational Eight DIAMONDS[b,c] (Rauthmann & Sherman, 2018)
Multidimensional Emotion Questionnaire[b,c] – intensity of emotions (Klonski et al., 2019)
Description of crying episode[b] • description of situation. • were did the crying episode took place? • how many persons were present? • what did the other person(s) do? • did trigger of crying and crying occur at the same time? • did crying change the situation? • felt better or worse, more calm or more agitated after crying?
Description of episode in which participant felt like crying[c] • description of situation. • were did the episode took place? • how many persons were present? • what did the other person(s) do?

Note. [a]was assessed every evening, [b]was assessed when crying episode was reported, [c]was assessed when participant felt like crying during the day.

R-Code for power-analysis – Study 4.

```
library(kappaSize)
CI5Cats(kappa0=0.8,kappaL=0.70,kappaU = 0.90 ,props=c(0.23,0.27,0.14,0.05,0.31),
raters=3,alpha=0.05)
```

#Please note that we converted the relative frequencies of the FRC from Study 1 so that they sum to 1.

Table S13 – Study 4. *Multilevel model regressing time on affect and arousal.*

	Affect predicted by time			Arousal predicted by time		
Predictors	Estimates	CI	*p*	Estimates	CI	*p*
Intercept	3.67	-3.53 – 3.81	<.001	2.44	2.29 – 2.59	<.001
Time	0.01	-0.01 – 0.03	.362	0.00	-0.02 – 0.02	.934
Time²	0.02	0.01 – 0.03	<.001	-0.04	-0.05 – 0.03	<.001
Random Effects						
σ^2	0.62			0.99		
τ_{00}	0.29			0.32		
ICC	0.32			0.31		
N	71			71		
Observation	1547			1547		
Marginal R^2/ Conditional R^2	0.007/ 0.327			0.016/ 0.322		

Notes. τ_{00} = variance between individuals, σ^2 = variance between crying episodes.

Table S14 – Study 4. *Multilevel model regressing time and reason on affect and arousal.*

	Affect predicted by time			Arousal predicted by time		
Predictors	Estimates	CI	*p*	Estimates	CI	*p*
Intercept	3.87	3.69 – 4.04	<.001	2.17	1.99 – 2.36	<.001
Time	0.01	-0.03 – 0.05	.673	-0.02	-0.07 – 0.02	.263
Time²	0.00	-0.02 – 0.02	.986	-0.02	-0.04 – 0.01	.196
Loneliness	-0.41	-0.59 – -0.23	<.001	0.45	0.26 – 0.64	<.001
Impotence	-0.04	-0.38 – 0.30	.820	0.15	-0.21 – 0.52	.405
Overload	-0.34	-0.52 – -0.16	<.001	0.44	0.24 – 0.63	<.001
Harmony	0.14	-0.11 – 0.40	.265	.021	-0.06 – 0.48	.125
Time * Loneliness	0.00	-0.05 – 0.05	.954	0.05	-0.01 – 0.10	.112
Time * Impotence	-0.01	-0.12 – 0.09	.810	-0.01	-0.13 – 0.10	.822
Time * Overload	-0.01	-0.05 – 0.06	.788	0.03	-0.03 – 0.09	.272
Time * Harmony	-0.01	-0.08 – 0.07	.873	0.02	-0.06 – 0.10	.662
Time² * Loneliness	0.04	0.01 – 0.07	.021	-0.02	-0.06 – 0.01	.136
Time² * Impotence	0.02	-0.04 – 0.08	.488	-0.06	-0.12 – 0.00	.060
Time² * Overload	0.04	0.01 – 0.07	.004	-0.04	-0.07 – 0.01	.010
Time² * Harmony	-0.03	-0.07 – 0.01	.176	0.01	-0.04 – 0.06	.674
Random Effects						
σ^2	0.61			0.70		
τ_{00}	0.26			0.28		
ICC	0.30			0.28		
N	71			71		
Observation	1547			1547		
Marginal R^2/ Conditional R^2	0.032/ 0.321			0.046/ 0.316		

Notes. τ_{00} = variance between individuals, σ^2 = variance between crying episodes.

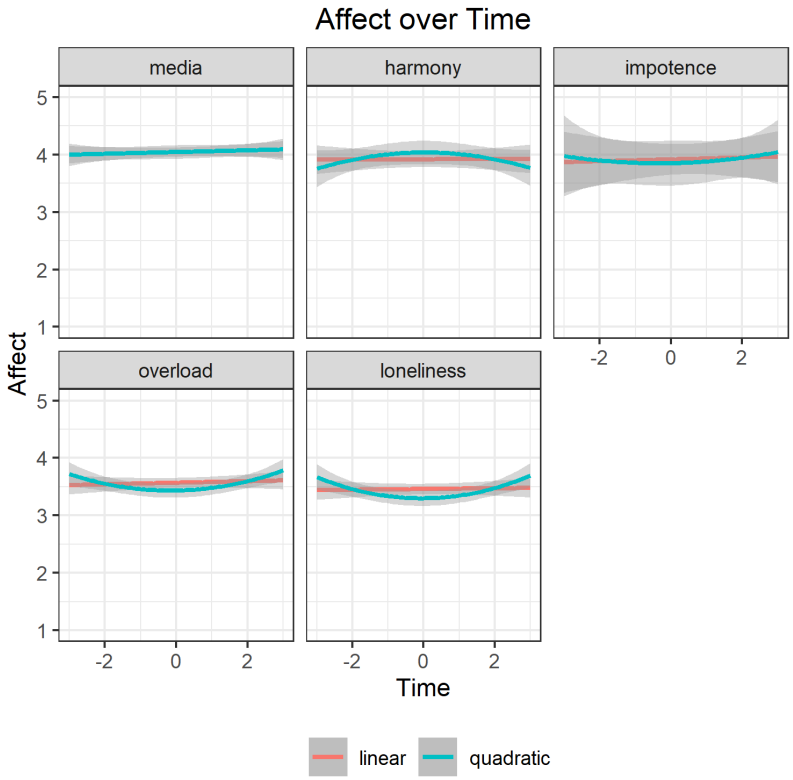

Figure S5 – Study 4. Time-course of affect (t=0: crying day; Barthelmäs et al., 2022).

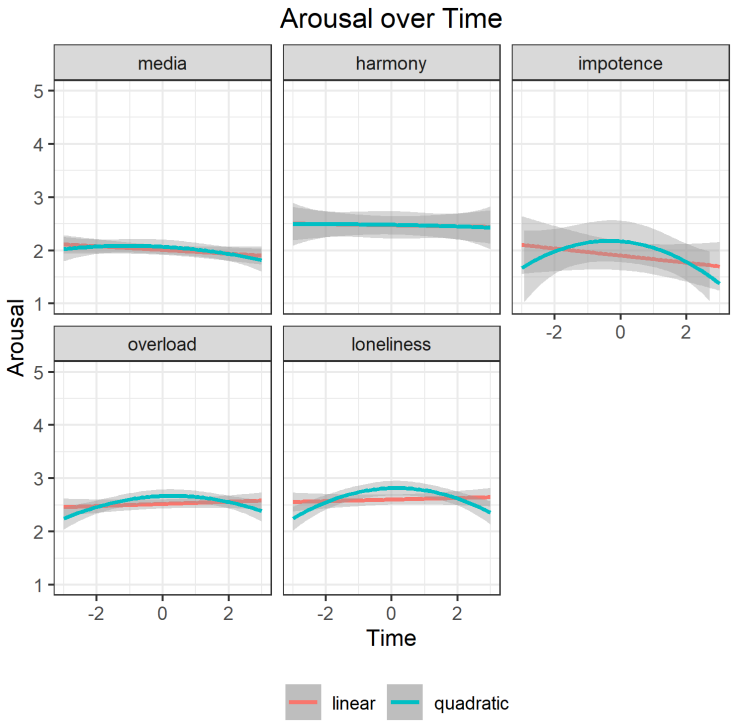

Figure S6 – Study 4. Time-course of arousal (t=0: crying day; Barthelmäs et al., 2022).

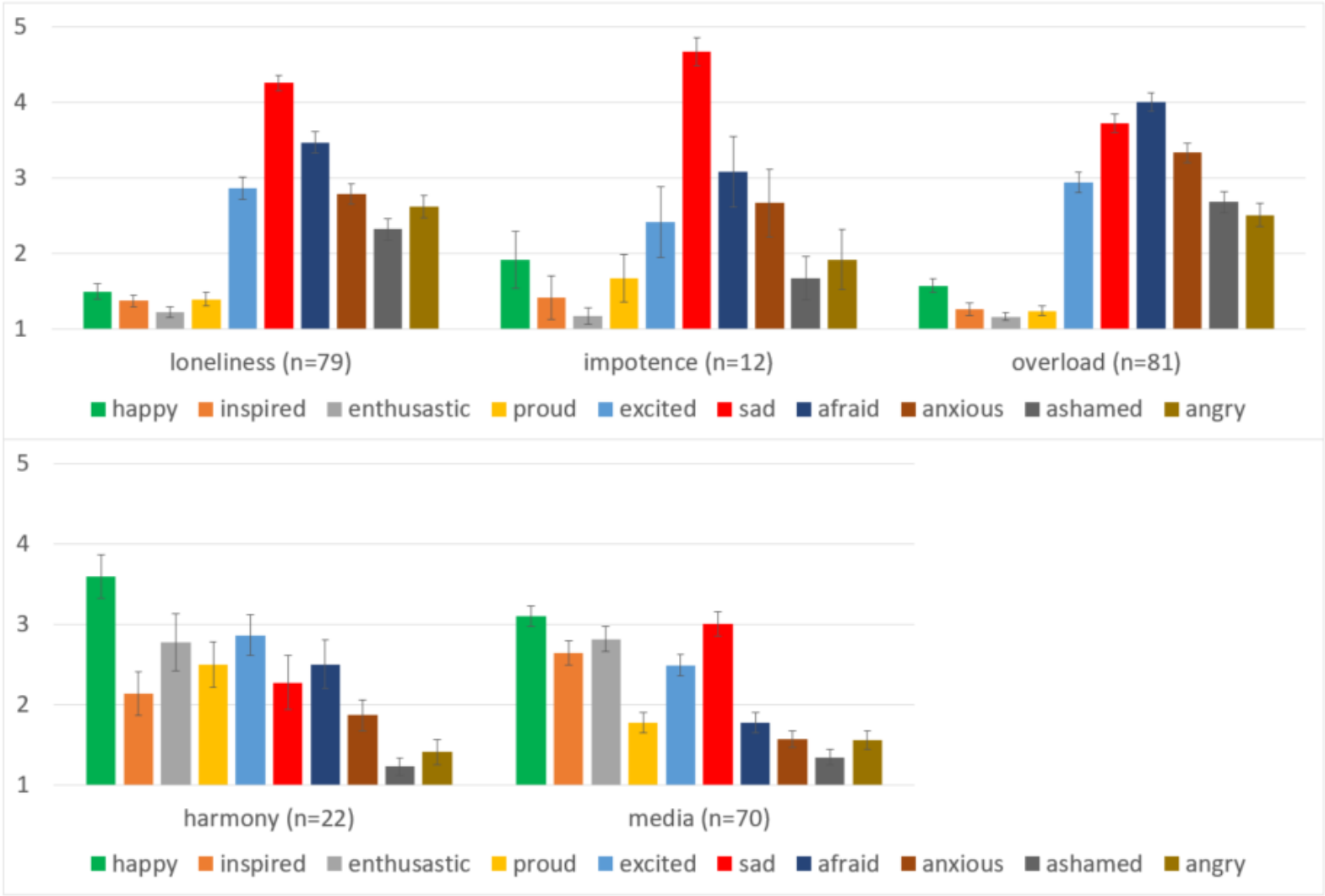

Figure S7 – Study 4. Emotion intensity for FRC. Error-bars denote +/- 1 SE (Barthelmäs et al., 2022).

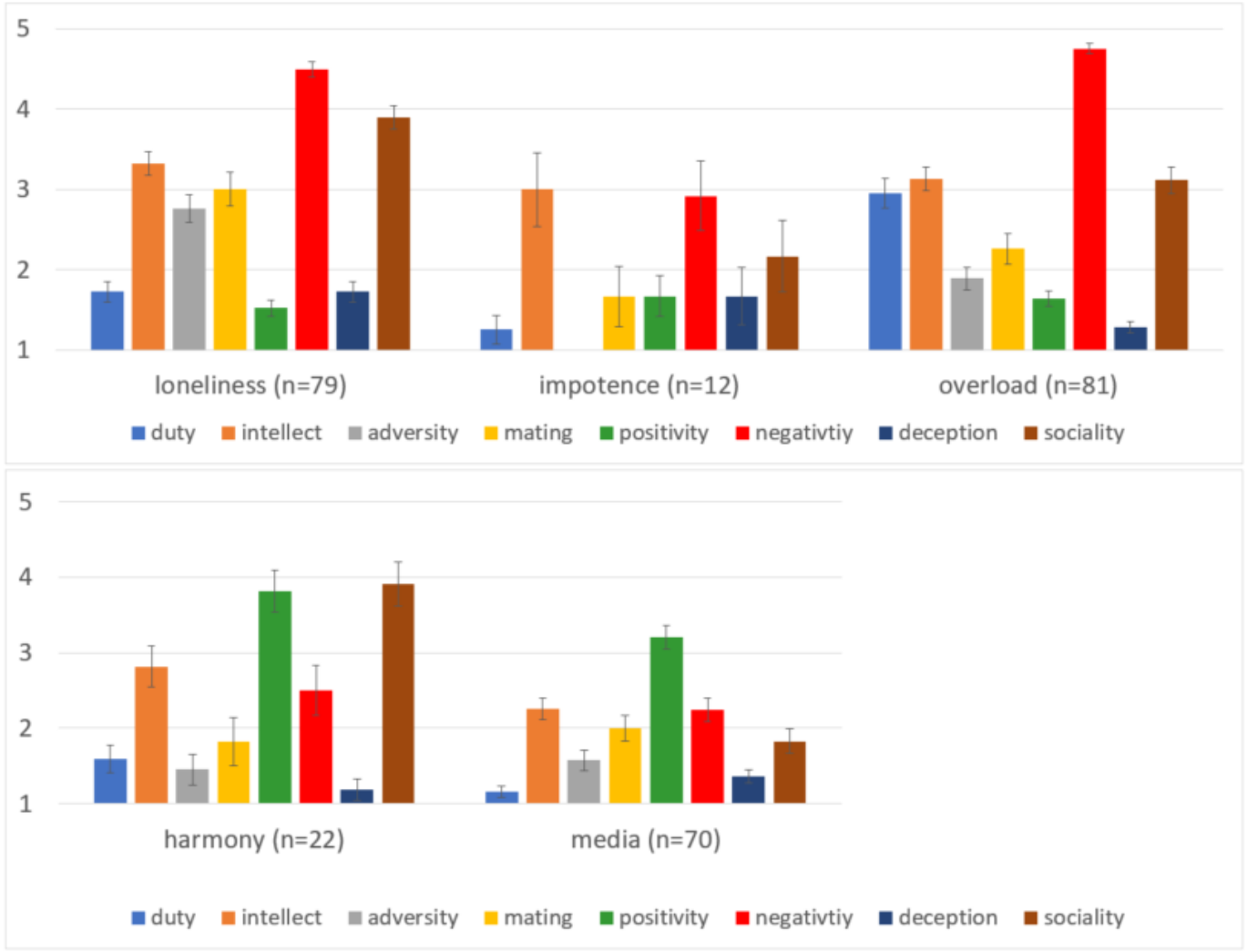

Figure S8 – Study 4. 8 DIAMONDS for FRC. Error-bars denote +/- 1 (Barthelmäs et al., 2022).

Appendix C

Data collection

Have any data been collected for this study already? Note: 'Yes' is a discouraged answer for this preregistration form.

No, no data have been collected for this study yet.

Hypothesis

We propse a theory-driven taxonomy for antecedents of emotional crying. We posit five different categories for antecedents of emotional crying. In this study we will test the following aspects: 1)do the categories differ with respect to crying characteristics (i.e., duration and intensity of crying)? 1a) crying duration is longer for conflict, death and stress compared to media (no difference between harmony and media) 1b) crying is more intense for conflict, death and stress compared to media (no difference between harmony and media) 2)do the categories differ with respect to situation characteristics? In contrast to media ... 2a) ...conflict is characterized by higher adversity, mating, negativity, sociality and lower positivity 2b) ...harmony is characterized by higher mating, positivity and sociality 2c) ...death is characterized by lower positivity as well as higher negativity and sociality 2d) ...stress is characterized by higher duty and negativity as well as lower positivity 3)do the categories differ with respect to basic needs? In contrast to media ... 3a) ...conflict is characterized by lower relatedness-satisfaction (higher relatedness-frustration) and lower self-esteem-satisfaction (higher self-esteem-frustration) 3b) ...harmony is characterized by higher relatedness-satisfaction (lower relatedness-frustration) and higher self-esteem-satisfaction (lower self-esteem-frustration) 3c) ...death is characterized by lower relatedness-satisfaction (higher relatedness-frustration) and lower autonomy-satisfaction (higher autonomy-frustration) 3d) ...stress is characterized by lower autonomy-satisfaction (higher autonomy-frustration), lower competence-satisfaction (higher competence-frustration) and lower self-esteem-satisfaction (higher self-esteem-frustration) 4)do the categories differ with respect to emotion intensity? In contrast to media ... 4a) ...conflict is characterized by lower happiness and higher sadness 4b) ...harmony is characterized by higher happiness and lower sadness 4c) ...death is characterized by lower happiness and higher sadness 4d) ...stress is characterized by lower happiness and higher sadness 5)do the categories differ with respect to their relation to subjective well-being? We will test these hypotheses in a sub-sample. Specifically, we will examine the hypotheses only for individuals who report a crying-episode within the past four weeks. 5a) the categories differ with respect to their relation with subjective well-being 5b) subjective well-being is higher for individuals who report a harmony-related crying episode comparted to individuals who report a media-related crying episode (within the past four weeks) 5c) subjective well-being is higher for individuals who report a media-related crying episode compared to individuals who report a conflict-, death- and stress-related crying episode (within the past four weeks) 6)do crying- and non-crying-episodes differ with respect to situation characteristics? 6a) crying-episodes are characterized by lower duty and positivity as well as higher intellect, adversity, mating and negativity research questions (no hypotheses): 7)can raters reliably assign participants' crying-reports to our proposed categories? 8)can participants assign their crying-episode to one of our proposed categories and does our rating match participants' ratings? exploratory analyses: -further emotion-differences between crying-categories? -emotion- and need-differences

between non-crying vs. crying? -how often is the "other-category" used when participants use the "Five-Reasons-to-Cry inventory"?

Dependent variable

1)crying characterisitcs: adapted from the Adult Crying Inventory (1 item for duration and intensity each) - Becht & Vingerhoets (2002) - ["How long did you cry?" in minutes"; "How intense was your crying?" 1=little intense, 7=very intense] 2)situation characteristics: S8*- Situational Eight DIAMONDS (8 items - order of the items will be randomized) - Rauthmann & Sherman (2017) - [1=not at all; 8=completely] 3)basic needs (autonomy, relatedness and competence): two items for satisfaction and two items for frustration each (12 items in sum - order of the items will be randomized) - Mabbe et al. (2018) - [1=not at all; 8=completely]. Adaption: the relatedness satisfaction items are adapted to also cover a relatedness to animals. *(self-esteem) two items for satisfaction and two items for frustration (4 items in sum- order of the items will be randomized) - Thewissen et al. (2008) - [1=not at all; 8=completely] 4)emotion intensity (happy, excited, enthusiastic, proud, inspired, sad, afraid, angry, ashamed, anxious): one item per emotion (10 items -order of the items will be randomized) - Klonsky et al. (2019) - [1=very weak; 8=very strong] 5)subjective well-being: WHO-5 well-being index (5 items - order of the items will be randomized) - Topp et al. (2015) - [1=at no time; 8=at all time]. Participants who report a crying episode within the past four weeks will be instructed to rate their subjective well-being regarding the time since crying. All other participants will be instructed to relate their subjective well-being rating to the past two weeks. 6)see 2) 7)three independent raters will read the crying-reports and assign them to one of our five proposed category 8)Five-Reasons-to-Cry inventory: self-formulated items to map our categories (3 items per category, in sum: 15 items+ 1 "other"-option) - [instruction: Please select the reason that is closest to why you were crying]

Conditions

How many and which conditions will participants be assigned to?

All participants will be instructed to report on their last crying-episode and to answer questions regarding this episode. Then, participants will then be instructed to report on an episode of the previous day. This will allow us to compare crying- and non-crying episodes. Participants will be randomly assigned to report on a non-crying-episode at 10:00, 12:00, 14:00, 16:00, 18:00, 20:00 or 22:00 at the previous day.

Analyses

1) we will use two multiple regressions to analyze difference between the categories. DV1=duration, IV=Five Reasons to Cry DV2=intensity, IV=Five Reasons to Cry Media serves as reference-category as the IV are entered as dummy variables 2) we will use a multinomial regression to analyze differences for the situation characteristics (IV) between the Five Reasons to Cry (DV). Media is the reference category. 3) we will use a multinomial regression to analyze differences for the basic needs (IV) between the Five Reasons to Cry (DV). Media is the reference category. 4) we will use a multinomial regression to analyze differences for the emotion intensity (IV) between the Five Reasons to Cry (DV). Media is the reference category. 5) we will use an oneway-ANOVA to examine differences for WHO-5 between the Five Reasons to Cry. We will used planned contrasts the examine hypotheses 5b and 5c. 6) we will use a logistic regression to examine situation-characteristics-differences (IV) between crying-

vs- non-crying-episodes (DV: 0=non-crying; 1=crying) 7) we will calculate Fleiss' kappa to examine the interrater-reliability 8) we will calculate Fleiss' kappa to examine the match between participants' rating and raters' ratings given the number of tests (in sum: 9), we set the significance level to alpha = .001

Outliers and Exclusions

the study contains two attention-check items ("this is an attention-check item, please answer 'completely' "). Participants will be excluded from the study if they answer one of these items incorrectly. -we ask participants to report on an episode of the previous day in order to sample non-crying episodes. If a participant indicates that s/he cried during this episode, this episode will be excluded from the analyses comparing non-crying- vs. crying-episodes. -for the analyses 1) 2) 3), 4), 5) and 6) we will only consider crying-episodes that fall into one of our five proposed categories. That is, crying-episodes assigned to "other" or "vague" will not be considered for these analyses. -due to the open-response format for 'crying duration' one could think about the exclusion of outliers. Since we find it difficult to define a meaninful limit here, we refrain from defining an outlier-criterium for 'crying duration'. -participants who report not having cried within the past 5 years are excluded from all analyses.

Sample Size

We aim for a sample size of n= 720. We used G*Power to determine the sample size. A-priori power analyses cannot be performed for multinomial regressions in G*Power. Accordingly, we decided to use an analysis with structural similarities to multinomial regressions. We determined sample size for a MANOVA with five groups (i.e., FRC), 8 response variables (i.e., 8 DIAMONDS), a power of $(1 - \beta) = .95$, $\alpha = .001$ and $f^2 = .02$ (small effect). This resulted in a required sample size of n = 720.

Other

for exploratory analyses we also record the following aspects: -'how long has it been since the last crying-episode?' -'how many times have you cried in the last 4 weeks due to the mentioned reason?' -'how often did you cry within the past four weeks?' -we will record who was present in the crying- and non-crying episodes. -'how typical was the previous day (non-crying-episode)?' -'what is your current occupation?' -'what is your age, gender, relationship status?'

Name

Crying_Taxonomy_German_Sample

Finally

Survey

Other

No response