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The Control-Arousal Signal (CAS) Model – A Theory of Human Emotional Crying

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Abstract

Human emotional crying remains an enigmatic phenomenon despite its universality throughout life. The Control-Arousal Signal Model (CAS) presented here is an integrative framework that unifies physiological, cognitive, and social perspectives on crying. It posits that emotional crying emerges when a perceived loss of control coincides with a sudden increase in arousal, evoking an emotional response and the expression of crying, including vocalizations and tears. The CAS conceptualizes crying as a five-phase temporal process—from stimulus appraisal to post-crying regulation—and highlights interpersonal signaling of loss of control as its primary function, with intrapersonal regulation as a secondary, context-dependent outcome. The CAS reconciles contradictory evidence, accommodates both negative and positive crying, and accounts for developmental, situational, and cultural moderators. The model generates testable hypotheses regarding the determinants, functions, and outcomes of crying. Its implications extend to developmental psychology, clinical practice, emotion regulation, and cross-cultural studies, offering a comprehensive framework for understanding human emotional crying.

Keywords: emotional crying, emotion regulation, social signaling

Introduction

Watching a beautiful sunset, feeling compassion for those in need, hearing that a friend has passed away, struggling with a deadline, experiencing extreme pain or intense orgasm, or feeling incompetent when blundering at work - these are just a

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few examples of situations that can make people cry. Which process unifies these rather different situations that can make people cry?

Emotional crying (hereafter, *crying*) is ubiquitous and accompanies us from our first scream to our last breath. Scientific evidence on crying remains limited, with emotion researchers considering it a riddle (Vingerhoets & Bylsma, 2016). Research has provided various perspectives on *when* (what are the *determinants* of crying?), *why* (what is the *function* of crying?), and *how* (what are the *processes* involved in crying?) people cry for emotional reasons (Gračanin et al., 2018; Sznycer et al., 2025). These range from psychodynamic theories that view crying as a safety valve regulating emotional overflow (Bindra, 1972; Sadoff, 1966), to physiological approaches that argue crying signals high arousal (Gross et al., 1994; Tomkins, 1963), cognitive models that focus on reappraisal and emotional resolution (Efran & Spangler, 1979), theories that highlight experienced and signaled helplessness (Frijda, 1986; Miceli & Castelfranchi, 2003), or socio-psychological accounts that focus on the frustration or satisfaction of basic needs (Barthelmäs et al., 2022). Notably, these approaches sometimes conflict, fail to account for inconsistent empirical evidence, are speculative, or rely mainly on anecdotal evidence.

Here, we aim to integrate these models by considering empirical findings on the determinants, functions, processes, and moderators of crying. After defining the multifaceted concept of crying, we introduce the Control-Arousal Signal (CAS) Model, outlining its main components, determinants, temporal dynamics, functions, and moderators. We apply the model to different crying cases, derive theoretical predictions, identify gaps in the empirical literature, and conclude with limitations and directions for future research.

Emotional Crying: Theories and Functions

The Concept of Emotional Crying

Like previous researchers (Barthelmäs et al., 2024; Vingerhoets, 2013), we define emotional crying as a complex secretomotor response involving the tear release from the lacrimal apparatus, facial muscle contractions (frontalis, orbicularis oculi, corrugator, zygomaticus, mentalis, and depressor anguli oris; Bylsma et al., 2019), and vocalizations such as whining, calling, shouting, screaming, wailing, or sobbing. These expressive behaviors may co-occur, and their display often depends on the intensity of the emotional episode (Wróbel et al., 2025c), the crier's developmental stage, and social or cultural norms (van Hemert et al., 2011). While single expressive behaviors (e.g., vocalizations alone) do not constitute a crying episode, their combination does (Vingerhoets, 2013; Wróbel et al., 2025a).[1]

Importantly, emotional crying involves *emotional* tears, which are distinct from *basal* tears that lubricate, nourish, and protect the eye, and *reflex* tears, which are caused by irritants such as wind, sunlight, dust, or chemicals, as in cutting onions

(Murube, 2009). Both emotional and reflex tears are produced by the lacrimal gland (Bylsma et al., 2019). In the literature, vocalizations without tears are commonly labeled as *crying*, while crying with tears or tears alone are labeled as *weeping* (Bellieni, 2017). Additional features may include a lump in the throat, laryngeal muscle contractions (Roseman et al., 1994; Vingerhoets et al., 1997), or altered breathing (Vingerhoets et al., 1997) during or prior to crying. Importantly, a lump in the throat is often considered an indicator of *feeling like crying* (Pelowski, 2015).

There is limited research on whether specific expressive behaviors are required for an expression to be classified as crying, but the focus on expressive behaviors varies considerably by developmental stage (Zeifman, 2012). For instance, while vocalizations are most frequently reported in infants and children, they become less common and tears become more prominent in adults (Vingerhoets, 2013; Zeifman, 2012). Despite a fully developed lacrimal apparatus, newborns typically do not shed emotional tears until two to three months of age (Sadoff, 1966). This distinction is also reflected in scientific research on infant and adult crying, with studies focusing on infant vocalizations and adult tears.

Phylogenetically, distress vocalizations are observed in both mammals and birds (Lingle et al., 2012), and there exists a responsiveness to such calls across mammalian species (Lingle & Riede, 2014). Interestingly, there is no systematic evidence that animals other than humans can shed emotional tears, and this has been considered a uniquely human capacity (Vingerhoets, 2013; however, see Murata et al., 2022). Humans may have developed emotional tears because (a) intense vocalizations put pressure on the eyeballs, resulting in reflex tears, and/or (b) tears compared to vocalizations were perceived as less distressing by observers and thereby encouraged (Vingerhoets, 2013).

Following previous theories, we consider crying a unified phenomenon comprising different expressive behaviors (Miceli & Castelfranchi, 2003; cf. Kottler & Montgomery, 2001). Nevertheless, we consider differential effects depending on the type of expressive behavior (Bellieni, 2017). For instance, some evidence suggests that vocalizations are perceived as more negative than tearing (Wróbel et al., 2025c) and that distinct expressive behaviors may elicit distinct interpersonal processes (Gračanin et al., 2014).

Theories of Emotional Crying

A considerable amount of research has focused on when and why individuals cry (see Kottler & Montgomery, 2001; Vingerhoets et al., 2000 for reviews). Vingerhoets and colleagues (2000) differentiate theories by their focus, classifying them as reductionist (physiological factors) or ecological (socio-cognitive or psychological factors). Kottler and Montgomery (2001) distinguish between physiological (intrapersonal) and interpersonal (social) theories. We reviewed 18 theories, classified them by focus, and evaluated their empirical evidence

(Supplementary Note 1). We qualified theories based on two main dimensions: the proposed *determinants* and the proposed *function* of crying. For determinants, theories mainly highlight biological/physiological (e.g., high bodily arousal) or cognitive/psychological (e.g., appraisal of helplessness) causes. For functions, theories primarily distinguish between intrapersonal functions (e.g., focusing on the crier) and interpersonal functions (e.g., focusing on the environment; see Table S1). Since previous contributions have meticulously reviewed different theories and empirical evidence, we refer readers to those sources (Gračanin et al., 2018; Kottler & Montgomery, 2001; Sznycer et al., 2025; Vingerhoets et al., 2000; Vingerhoets, 2013) or to the Supplementary Material. Regarding the determinants of crying, we consider evidence for the roles of sympathetic arousal (Zickfeld & Grüning, 2021) and helplessness appraisal (Gračanin et al., 2021). Considering functions, there is mixed evidence for an intrapersonal regulation function, with results depending on methodological or measurement differences (Gračanin et al., 2018), whereas there is consistent evidence for an interpersonal signaling function across the lifespan (Zickfeld & Wróbel, 2024).

The Control-Arousal Signal Model (CAS)

This contribution introduces the Control-Arousal Signal Model (CAS), an integrative theoretical framework that explains crying. This model adds to the existing literature on crying by addressing four main points. First, it provides an integrative perspective that aims to encompass the full range of theories about crying. Second, it relies on the currently available empirical evidence. Third, it provides a unified framework for understanding crying from a lifespan perspective, being applicable to both infant and adult crying. Fourth, it considers the crying process by focusing on both its determinants and functions.

Emotion Components

Given that crying is one component of emotion, we first consider *emotion* as a basic theoretical foundation (Vingerhoets et al., 2000). While there is considerable disagreement about the exact nature of the emotion process, most theories agree on the main components, including *cognitive* (stimulus appraisal), *feeling*, *motivational* (*action tendencies*), *somatic* (*physiological*), *emotion regulation,* and *motor* (*expression*) components (Moors, 2010). Crying is typically considered the motor component (Fontaine et al., 2007), allowing variation in other components, and it can occur in response to a range of emotions (Vingerhoets, 2013). Following most theories, we consider cognitive components (central in appraisal theories) and somatic components (important in constructionist theories) as important in defining crying, placing them early in the emotion process, with the motor component of crying occurring at the end (Moors, 2010). We are agnostic about the exact causal

processes of the other components, including motivational, emotional, and other motor components (e.g., expressions not directly related to or preceding crying).[2]

Figure 1 schematically summarizes the emotion components and the CAS. It follows the process of crying from stimulus to outcome, focusing on specific determinants, functions, outcomes, and moderators. The model emphasizes that crying represents the motor component of an emotion. A stimulus, typically social and of high significance (Vingerhoets, 2013), triggers a perceived loss of control (cognitive component), which subsequently promotes a sudden increase in physiological arousal (somatic), motivations to reduce excessive arousal, motor expressions (e.g., facial or body movements), and specific feelings determined by interactions with additional appraisal dimensions (ranging from negative to positive feelings). The individual may apply emotion regulation strategies to regulate excessive arousal and expressions, such as suppression, reappraisal, or distancing (Simons et al., 2013), and, once the perceived level of control reaches a crying threshold, start crying if these fail (or intentionally select crying) [3]. The main function of crying is interpersonal, signaling a perceived loss of control to observers. If successful, crying prompts others to provide support and help the crier regulate their excessive arousal and mood. In addition, crying can function as an intrapersonal regulatory mechanism to reduce arousal and improve mood, but its effectiveness is moderated by its signaling function (and other moderators). The appraisal of the stimulus, the crying threshold, and the effectiveness of these functions are moderated by a myriad of variables related to crying, the crier, the observer, the situation, and culture (Figure 1).

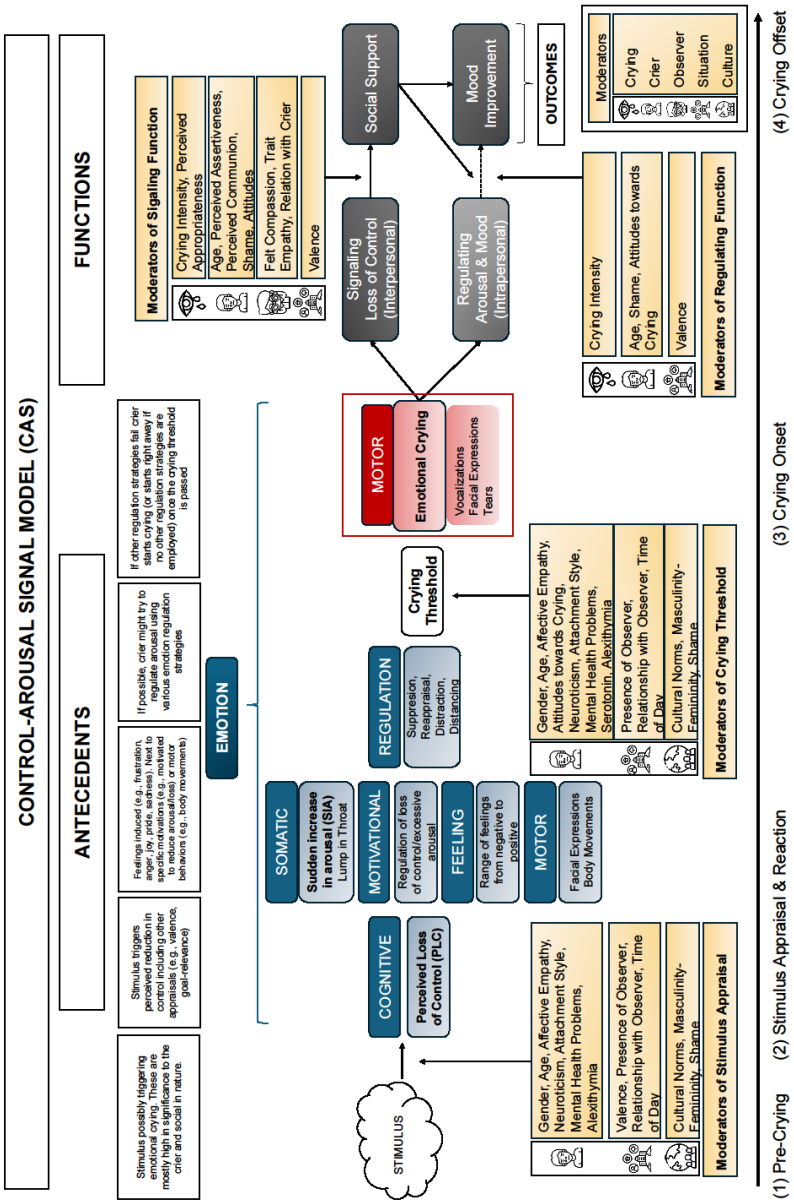
The CAS identifies five phases of crying that build on each other both temporally and causally: *pre-crying period*, *stimulus appraisal and reaction*, *crying onset*, *crying offset*, and *post-crying period*. We now discuss each phase, considering the determinants, functions, and moderators of crying. To clarify the overview of processes, we illustrate the trajectories of the main determinants of crying and valence across the different phases in Figure 2.

(1) Pre-Crying Period

Before the crying stimulus (or stimuli) is perceived and attended to, fluctuations in arousal, perceived control, and valence reflect a general state as the individual attends to the environment. We model this as the *pre-crying period* [Figure 2, (1)]. During this state, individuals may experience a range of emotions and notice changes in arousal or control, though there will be no crying response because the crying threshold is not reached. While the literature has provided several lists of stimuli or events that can trigger crying (Vingerhoets, 2013), the most systematic attempt has categorized events into five classes focusing on *loneliness* (e.g., separation from a close one)*, impotence* (e.g., death)*, overload* (e.g., stress or failure)*, harmony* (e.g., interpersonal closeness)*,* and *media* (Barthelmäs et al., 2022), while other taxonomies

Figure 1

Main Overview of the Control-Arousal Signal Model (CAS) of Emotional Crying



Note. Blue boxes refer to emotional components and their specific processes; the red box refers to crying; yellow boxes refer to different levels of moderators for the different steps of the model, focusing on moderators related to crying, the crier, the observer, the situation, and the specific culture. Note that box placement does not necessarily specify the temporal dynamics of each component; a temporal visualization is provided in Figure 2.

have further specified positive events into at least four categories focusing on *achievement* (e.g., winning a game), *beauty* (e.g., watching a sunset), *affection* (e.g., reuniting with an old friend), and *amusement* (e.g., seeing something extraordinarily funny; Zickfeld et al., 2020).

(2) Stimulus Appraisal & Reaction

In the second step [Figure 2, (2)], the stimulus is attended to, appraised, and triggers an emotion. We argue that crying is mainly determined by a combination of (1) a perceived loss of control (cognitive) and (2) a sudden increase in arousal (somatic).

Determinants of Emotional Crying

First, many cognitive theories emphasize that crying occurs in situations characterized by helplessness or frustration (Vingerhoets & Bylsma, 2016), a view supported by empirical evidence (Frijda et al., 1989; Vingerhoets et al., 1997). We build on appraisal theories by focusing on perceived *control*[4] (also referred to as *coping potential* or *power*), defined as the perceived ability to cope with a situation (Scherer & Moors, 2019).[5] Crucially, we focus on a perceived loss of control (PLC) relative to an individual's baseline, as crying can also occur in positive situations, including those with high-control (Zickfeld et al., 2020). Therefore, crying is not necessarily caused by low perceived control but by a PLC relative to a baseline level. The extent of PLC depends on both situational characteristics and individual differences in baseline control. The appraisal refers to the crier's subjective evaluation (unconscious or conscious), which may differ from objective control. Prior research has demonstrated conceptual overlap among control appraisals and related constructs such as *helplessness* (Frijda et al., 1989), *self-control* (Troup & Dewe, 2002), and *assertiveness* (Inglis et al., 2018), making findings from these concepts informative for the present model.

Second, theoretical models have emphasized an increase in somatic physiological activity regarding crying (Table S1), and empirical evidence has confirmed this, although it is mainly correlational (Zickfeld & Grüning, 2021). While this aspect focuses on *physiological* arousal, it can also co-occur with *psychological* arousal or stress. Here, we refer to a *sudden increase in arousal* (SIA) as the second component. The magnitude of SIA depends on stimulus-related, situational, and individual factors, including prior arousal levels, as changes are experienced relative to an existing arousal baseline (which also depends on sympathetic-parasympathetic coactivation, Berntson et al., 1993). Unexpected or highly salient events thus elicit stronger arousal responses than anticipated ones (see Fiske, 2019). SIA is also accompanied by related somatic changes, such as a lump in the throat, altered breathing, and muscle tension (Davydov et al., 2011; Figure 1), with a lump in the

throat often preceding crying and serving as a marker of *feeling like crying* (Pelowski, 2015).

The interaction between PLC and SIA determines the likelihood, intensity, and duration of crying. The higher the SIA and the higher the PLC, the more intensely and (probably) longer the individual will cry. We also predict that their interaction influences the occurrence of different expressive behaviors. A smaller PLC might only elicit a single tear, which is typically associated with higher perceived control by observers (Zawadzki et al., 2013), whereas a larger PLC is expected to elicit vocalizations or intense facial expressions (Wróbel et al., 2025b). PLC and SIA can also mutually reinforce each other. A stronger SIA (or repeated increases) can reduce evaluations of control (Starcke & Brand, 2016), and PLC can make SIA feel more excessive (Scherer & Moors, 2019).

Importantly, PLC or SIA alone is not sufficient to cause crying; the combination of both is necessary. Many emotions, such as anger, fear, jealousy, or joy, involve heightened arousal (Siegel et al., 2018) but should not result in crying unless they also include PLC. For example, anger is typically associated with high arousal and high perceived control and motivates behaviors such as attack or coercion (Fischer & Roseman, 2007). However, anger can also involve reduced control, particularly in low-power individuals, and may then be accompanied by crying (Fischer & Evers, 2010). Similarly, sadness is prototypically associated with crying (Cordaro et al., 2016), yet sadness without crying is characterized by low arousal (Fontaine et al., 2007), whereas sadness with crying involves heightened physiological activation (Kreibig, 2010). These findings suggest that any emotion characterized by both PLC and SIA can elicit crying.

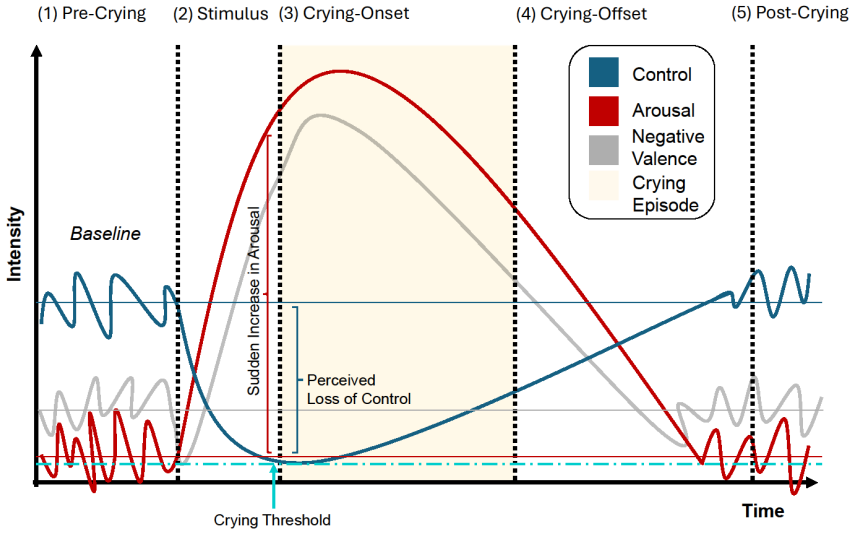
In addition to cognitive and somatic components, stimulus appraisal also influences motivational, feeling, motor, and emotion regulation components.[6] These components will vary depending on the combination of the remaining appraisals. For instance, the combination of goal relevance, goal blocking, other agency, negative valence, and unfairness is likely to result in anger and motivate attacks or coercion (Fischer & Roseman, 2007). In contrast, the combination of goal relevance and attainment, other agency, positive valence, and fairness may elicit a sense of gratitude and motivate reciprocal and prosocial behaviors (Algoe, 2012). Nevertheless, both situations could include crying as an expression if they involve PLC and SIA.

Finally, although PLC and SIA are necessary for crying, they are not sufficient, as numerous moderators influence the occurrence and expression of crying (Figure 1). Similarly, as they develop, humans may employ different emotion regulation strategies to manage their emotions and avoid crying due to negative attitudes, situational constraints, or anticipated negative reactions from observers (Sharman, Dingle, & Vanman, 2019; Sharman, Dingle et al., 2019; Simons et al., 2013). Such strategies may include suppressing the emotion, reappraising it by reinterpreting the stimulus, distracting themselves, or distancing themselves by escaping the situation (Gross, 2015). Since crying may be caused by PLC, the possibility of applying

alternative strategies also depends on the remaining levels of control, suggesting that positive, less intense crying can be regulated more easily than negative or intense crying.

Figure 2

Schematic Representation of a Possible Negative Crying Episode That Is Successfully Regulated According to the CAS, Including Temporal Trajectories (Time) of Control, Arousal, and Negative Valence (Intensity) Levels



Note. Perceived Loss of Control (PLC) is defined as the difference in control intensity between the onset of crying and the control baseline. The crying threshold is determined by individual, situational, and cultural moderators and is set at low levels of control in this example. The figure does not claim numerical accuracy for the specific intensity levels of its variables, but rather provides a stylized overview of a possible process.

(3) Crying Onset

Crying depends not only on PLC and SIA but also on an individually, situationally, and culturally determined *crying threshold* (see Figures 1 and 2). The *crying threshold* represents a subjective level of control at which the individual cannot avoid crying [7] by other means, and once PLC exceeds this threshold, a crying episode is initiated (see Figures 2 and 3). As the crying threshold is approached, the individual may experience *feeling like crying* (Pelowski, 2015), with tears welling up and a lump in the throat, at which point crying can still be regulated. Determining when the actual onset of crying occurs is complex and has been the subject of discussion (Gračanin & Vingerhoets, 2024). Here, we argue that crying begins when the crying threshold is crossed, the individual (subjectively) experiences

it, and specific crying behaviors (e.g., tears or vocalizations) are objectively observed. More specifically, we define the exact time of crying onset as the point at which PLC reaches the individual's crying threshold. While we are aware that it can be challenging to provide a standardized, objective measure of this moment, we believe it represents the most valid operationalization given the current literature. Importantly, the crying threshold will differ across (e.g., personality) and within (e.g., hormonal fluctuations) individuals, and is influenced by a range of moderators. We now provide a review of the most studied moderators (Figure 1 and Table S2). Importantly, recent evidence suggests that these moderators do not operate in isolation but also interact in complex ways (Barthelmäs et al., 2025). While these moderators mainly influence the crying threshold (i.e., whether a person will start crying after a stimulus triggers a PLC and SIA), it is also possible that they moderate the initial appraisal of the stimulus (e.g., individuals low in trait control being more susceptible to losses, Figure 1).

Moderators of the Occurrence of Emotional Crying

Crying occurrence is thus moderated by various individual, situational, and cultural moderators that systematically influence when it is triggered, suppressed, or expressed (see Table S2 and Supplementary Note 2 for a more detailed overview and references). In the CAS model, these moderators primarily influence crying by altering baseline levels of perceived control, emotional reactivity, or the crying threshold (Figure 1). At the individual level, demographic characteristics, personality, and psychological state play important roles (Table S2).

Robust findings indicate a *gender* difference, with women reporting higher crying frequencies than men (Barthelmäs et al., 2025). Evidence increasingly suggests that these differences are driven less by biological factors (e.g., a possible role of testosterone) and more by socio-developmental factors, such as gender norms, greater affective empathy, and lower assertiveness in women (Bylsma et al., 2019). We argue that these characteristics are associated with lower baseline control and a lower crying threshold, particularly for negative crying (Zickfeld et al., 2020). *Age* is thought to moderate crying by reflecting developmental changes in regulation capacities and control. Crying is most frequent in infancy, when regulatory abilities are limited and crying serves as a primary signal of distress (Zeman et al., 2006). Across childhood and adolescence, crying generally declines as alternative regulation strategies develop and autonomy increases (Hastrup et al., 2002; Van Tilburg et al., 2002). In adulthood and older age, crying becomes more differentiated. Negative crying decreases, while positive crying increases, especially in later life. These patterns align with findings on age-related changes in adaptive emotion regulation, a greater focus on positive emotions (Charles & Carstensen, 2010), and higher self-control (Young & Mikels, 2020), all of which are considered to influence PLC and the crying threshold for positive triggers.

Affective empathy consistently predicts higher crying frequency (Zickfeld et al., 2022), likely by increasing the ability to understand both one's own and others' experiences and lowering the crying threshold. *Neuroticism* is positively associated with crying (Barthelmäs & Keller, 2021), particularly in negative contexts, and is related to lower baseline control and a lower crying threshold (Judge et al., 2002). *Attachment style* shows differentiated effects. Anxious attachment, characterized by heightened sensitivity to abandonment and relational threat, is associated with increased crying (Denckla et al., 2014; Fiori et al., 2013, 2017), whereas avoidant attachment is associated with reduced crying (Fiori et al., 2017). We consider the increased sensitivity to relationships in anxious attachment to influence PLC and lower the crying threshold, since most crying triggers are interpersonal (e.g., related to disruption or termination of a relationship; Vingerhoets, 2013).

Positive attitudes toward crying are associated with greater crying frequency (Millings et al., 2016; Sharman, Dingle, & Vanman, 2019), suggesting that when crying is perceived as functional or acceptable, individuals are more willing to use it as a regulation strategy (Simons et al., 2013), which lowers the crying threshold. In contrast, *alexithymia*, characterized by reduced emotional experience, awareness, and labeling, predicts lower crying frequency (Zickfeld et al., 2022), likely due to diminished emotional reactivity and altered appraisal processes that raise the crying threshold. *Mental health* shows a nuanced relationship. Non-clinical stress and reduced well-being are associated with more crying (Barthelmäs et al., 2025; Fiori et al., 2013), most likely through reduced control, whereas clinical depression is often associated with reduced emotional reactivity and reduced crying (Bylsma, 2021; Vingerhoets et al., 2007), potentially mediated by neurobiological factors such as serotonin levels (Van der Veen et al., 2012).

Situational moderators influence crying by altering appraisals of PLC and affecting potential costs and benefits (Table S2). *Emotional valence* is a critical factor. While both positive and negative situations can elicit SIA (Behnke et al., 2022), positive crying is generally considered to involve higher baseline control, resulting in shorter, less intense, easier-to-regulate, and more successful attempts to restore emotional balance (Zickfeld et al., 2020). However, positive crying is often perceived as an overwhelming response to something positive (Vingerhoets & Bylsma, 2016). *Social context* strongly moderates crying expression. Crying is more likely when individuals are alone (Bylsma et al., 2008) or in the presence of a few close others (Barthelmäs et al., 2024), when the likelihood of receiving support is higher and social costs (e.g., shame) are lower. In contrast, crying in front of non-close others can entail status loss and vulnerability, particularly for individuals with high baseline control (Huron, 2024; Sznycer et al., 2025). *Time of day* further moderates crying, with increased crying in the evening likely reflecting reduced self-control (Baumeister et al., 2019), increased sleepiness (Dolan et al., 2009), and safer contexts for emotional release (Vingerhoets, 2013), which may affect the crying threshold.

Finally, *cultural norms* shape crying thresholds by prescribing when and for whom crying is acceptable (Sharman, Dingle, et al., 2019). Studies find that country-level masculinity and shame are negatively associated with successful regulation of crying (Becht & Vingerhoets, 2002), likely increasing the crying threshold (Table S2).

Once a crying response is initiated, several pathways are possible for the crier. First, crying can fulfill its main functions: signaling a perceived loss of control (PLC) and attracting social support from observers, which helps criers regulate excessive arousal and feelings. Second, when no observers are present, criers can successfully use crying to regulate their excessive arousal and feelings. Third, social support is not attracted, and/or the individual is not successful in regulating his or her excessive arousal and feelings (Figure 3b). In this case, the crier might continue crying or use different emotion regulation strategies once an adequate level of control is regained, or, in the extreme cases, the body may shut down (e.g., by falling asleep). We now turn to the specific functions of crying and identify their moderators (Figure 1).

Functions of Emotional Crying

Signaling Loss of Control. Based on previous theoretical and empirical evidence (Table S1), we argue that the primary function of crying throughout the lifespan is to signal a perceived loss of control (i.e., a sense of *need* or *helplessness*; Figure 1). The main purpose of this signal is to communicate this loss to the environment and elicit social support from (close) observers. Observers seem to employ different types of support (e.g., comforting vs. distracting) depending on the perceived regulatory need of the crier (Pauw et al., 2019). Providing social support will help the crier regulate their excessive arousal and feelings, a process often referred to as *co-regulation* or *social soothing* (Gračanin et al., 2014).

From an evolutionary perspective, crying as a signal is essential for pre-verbal infants to attract caregivers and increase their chances of survival, a phenomenon also referred to as the *acoustic umbilical cord* (Newman, 2007). Vocal crying is a powerful signal that can be transmitted over long distances to effectively attract caregivers, while visual signals of tears reduce the potential costs of attracting predators and are also perceived as less distressing (Huron, 2024; Sznycer et al., 2025). When the individual develops different capacities for emotion regulation, crying becomes less frequent but still serves the same purpose. Ultimately, by conveying information about PLC, crying also signals the significance of the situation or relationship to both the crier and the observer (Paoli et al., 2022; Sznycer et al., 2025). This becomes more apparent when individuals cry in response to positive situations. For instance, crying in response to a beautiful painting signals to observers a PLC (e.g., the crier is impressed by its aesthetics) but also provides information that the stimulus is significant to the crier (e.g., they appreciate art; Pelowski, 2015).

A variety of empirical evidence supports the notion that crying signals PLC (MacArthur & Shields, 2019; Zickfeld & Wróbel, 2024). Across different cultural contexts, it has been confirmed that individuals perceive criers (compared to those with neutral expressions) as more helpless and are more inclined to offer them social support (Zickfeld et al., 2021). Further indirect evidence suggests that people who cry frequently have better social integration and feel more connected to others (Hesdorffer et al., 2018; Phinney et al., 1986), suggesting that crying is mainly used by those who have close relationships with others likely to respond to their signal.

Regulating Arousal and Mood. We also acknowledge a more indirect function of crying, namely, regulating the crier's arousal and mood through intraindividual processes without support from observers (Figure 1). As discussed earlier, SIA and PLC also increase negative affect. One function of crying is to decrease negative affect by reducing excessive arousal and increasing the individual's sense of control, thereby relieving tension or stress and improving mood (Gračanin et al., 2014). In infants, this occurs indirectly through social soothing, as crying alerts the caregiver to reduce excessive arousal (e.g., by providing food, changing diapers, etc.), thus serving primarily one function. We argue that across the lifespan, humans also begin to develop crying as a self-soothing regulation strategy, and the two functions become increasingly independent (Gračanin et al., 2014). Importantly, given empirical findings (Bylsma et al., 2008; Rottenberg et al., 2008), we think that the effectiveness of crying as an intraindividual emotion regulation mechanism is moderated by its interpersonal signaling function. That is, arousal and mood regulation will be most effective if (close) observers are present and respond positively (i.e., by providing support) to the crier (Figure 1).

However, a substantial proportion of adults report crying when alone, possibly influenced by social and cultural norms or heightened feelings of shame (Bylsma et al., 2008, 2011). How can this finding be explained if crying is most effective for arousal and mood regulation, if it can also attract social support from observers? First, there exists the possibility that while participants in the reported studies were alone in the sense that no other humans were physically present, others could have been symbolically present through messages or letters, evoked memories associated with certain people, the spiritual presence of a deity, or an emotional connection to fictional characters in movies or music (Vingerhoets, 2013). This raises the possibility of social support by the symbolic presence of others. Second, several hypotheses propose that crying can serve as an intrapersonal emotion regulator, but empirical evidence is either lacking or mixed. Physiological results indicate a reduction in sympathetic nervous system activity after crying, even in laboratory studies where social support from others is not possible (Zickfeld & Grüning, 2021). Findings also suggest that crying reduces respiratory rate (Zickfeld & Grüning, 2021), and it has been speculated that sobbing could regulate arousal and mood by inducing rhythmic regulation (Gračanin et al., 2014). Another perspective argues that crying, especially weeping, may trigger the release of hormones such as oxytocin,

which could help regulate arousal and mood (Gračanin et al., 2014). In animal studies, oxytocin administration is associated with reduced distress vocalizations, and in humans, oxytocin is involved in regulating parasympathetic activity, which is consistent with an intraindividual regulatory function (Bylsma et al., 2019). However, there is only limited direct evidence of oxytocin release during crying in humans, and it may be moderated by social support (e.g., touch, which promotes oxytocin release; Moberg & Petersson, 2022). Further, it is possible that crying itself is not responsible for regulating arousal and mood, but rather other emotion regulation strategies used in addition to crying, such as suppression, reappraisal, or distraction (Gross, 2015). If the crying response is unsuccessful in regulating one's state (e.g., failing to attract support), the crier might try other strategies, such as distracting themselves by thinking about another situation or experience (if their level of control allows). In sum, empirical evidence suggests that arousal and mood can be regulated by crying through intraindividual processes, even if this regulation may take some time (Gračanin et al., 2015). However, there is limited evidence about *how* this works. We consider the three discussed options as most promising and suggest that future research evaluate their roles more systematically. Importantly, it is questionable whether both sobbing and oxytocin can explain a reduced intraindividual regulation function in infants and toddlers.

What happens if arousal or mood is not successfully regulated through crying? In laboratory studies, participants often report a decreased mood and more negative affect after crying (Gračanin et al., 2014; Rottenberg et al., 2008), which may indicate unsuccessful regulation. If arousal cannot be successfully regulated, parasympathetic rebound may be one strategy to regain homeostasis (Hendriks et al., 2008). In the most extreme case, failing to regulate ongoing excessive arousal through crying might result in the body shutting down (e.g., crying yourself to sleep).

Moderators of Functions of Emotional Crying

We consider potential moderators separately for the interpersonal signaling and intrapersonal regulation functions, but in some cases (e.g., crying intensity), they may overlap (Figure 1). We consider characteristics of the crying response, the crier, the (potential) observer, the situation, and the culture. Detailed discussions of moderators related to the signaling function (MacArthur & Shields, 2019; Zickfeld & Wróbel, 2024) and the regulation function (Gračanin et al., 2014; Rottenberg et al., 2008) have been provided elsewhere; therefore, we focus only on the most important aspects and direct readers for in-depth considerations to these sources (Table S3 and Supplementary Note 3 for a detailed overview and references).

For characteristics of the crying response, we consider *crying intensity*. High crying intensity can amplify the signal of seriousness conveyed by tears and attract support, but it can also reduce perceived genuineness and appropriateness when accompanied by exaggerated facial expressions or vocalizations, thereby reducing support (Golding et al., 2003; Wróbel et al., 2025c) or even evoking negative

responses (e.g., Levitzky & Cooper, 2000; Reijneveld et al., 2004). Regarding the regulating function, high intensity reflects high SIA and PLC, making intraindividual regulation more difficult (Bylsma et al., 2011; Rottenberg et al., 2008). The *perceived appropriateness* of crying moderates social support, interacting with crying intensity, situational context, relationship, and cultural norms (Zickfeld & Wróbel, 2024). Crying in norm-incongruent situations (e.g., at work) is typically evaluated more negatively (Fischer et al., 2013) and is predicted to reduce support (Table S3).

For the crier, *age* is expected to moderate the effectiveness of crying as a signaling and regulatory strategy. Some evidence suggests that the signal function of tears is more potent for adults (Zeifman & Brown, 2011). Tears may be more adaptive in adults, as vocalizations could be perceived as more irritating and highlight PLC beyond a typical level. We predict that vocalizations are more effective in infants or children. For regulation, age and emotional development influence the availability of regulation strategies (Zeman et al., 2006), making successful intraindividual regulation difficult at a young age (Table S3). Similarly, signaling PLC criers are perceived as less *assertive*, which in turn influences the likelihood of attracting support (Zickfeld & Wróbel, 2024). At the same time, criers are regarded as more *communal*, emphasizing friendliness and morality, which also increases the likelihood of attracting support (Zickfeld & Wróbel, 2024). Studies indicate that these effects are further moderated by the intensity and appropriateness of crying (Table S3). Feelings of *shame* or *embarrassment* can moderate the effectiveness of signaling or regulatory functions (Rottenberg et al., 2008). *Shame*, often also evoked by PLC, can motivate withdrawal and escape (Miceli & Castelfranchi, 2018), which would fail to attract potential support from others (Becht & Vingerhoets, 2002; Bylsma et al., 2008). Since shame can further increase PLC, a greater loss of control may be more difficult to regulate (Becht & Vingerhoets, 2002). *Positive attitudes* can influence the success of both signaling and regulating functions (Millings et al., 2016; Sharman, Dingle, & Vanmen, 2019; Simons et al., 2013). Being aware that crying is a useful signal may prompt people to cry when observers are present, increasing the probability of receiving support (compared to crying alone). Positive attitudes should also result in a lower crying threshold at higher levels of control, making regulation easier (Simons et al., 2013; Table S3).

For observer characteristics, *felt compassion* by the observer has been found to mediate the success of support (Zickfeld & Wróbel, 2024). Higher perceptions of genuine loss of control are expected to increase felt compassion, which is further expected to be moderated by the observer's *trait affective empathy* (Table S3). The *relationship to the crier* is also important, with studies finding that individuals are more likely to help close others who are crying and report more frequently being supported by close others when crying (Barthelmäs et al., 2024; Sharman, Dingle, & Vanmen, 2019). The evolutionary perspective emphasizes an increased likelihood of support for kin or close others, increasing their chances of survival (Sznycer et al., 2025).

For situational characteristics, the *valence of the situation* suggests reduced PLC for positive crying, which should translate to less support (Zickfeld et al., 2021) and more effective intraindividual regulation (Bylsma et al., 2008; Ishii & Shinya, 2021; Rottenberg et al., 2008) compared to negative crying (Table S3).

Finally, evidence on cultural characteristics is limited, except for one study (Zickfeld et al., 2021), which found that participants across all countries, on average, reacted positively to crying, with increased intentions to help, while showing heterogeneity in the effect. A country's GDP and country-level well-being partly explained these differences, and the authors discussed the possibility that higher psychological well-being and greater resources are linked to more opportunities to provide support (Zickfeld et al., 2021).

(4) Crying Offset

Crying is considered *successful* if arousal and negative affect are reduced and control is increased [Figures 2, (4), and (3)]. It is unclear what level of control is needed to offset crying, but we assume it should be substantial enough to allow the crier to control the crying or employ other regulation strategies. In our schematic representation, we estimate crying offset at around a 50% regain of control (Figures 2 and 3), but such levels will likely differ across individuals (based on their baseline levels of control) and are subject to empirical testing. Research has typically considered crying offset once visual signs of crying are absent (e.g., no tears), but, as with crying onset, it is questionable whether this can validly and reliably reflect crying offset, as it also depends on the exact definition of crying. For simplicity, we also define the crying offset as the point at which the individual subjectively feels they have stopped crying and objectively ceases to produce visual or vocal signs of crying [Figure 2, (4)] while acknowledging that there may be better cognitive or somatic indicators. By no means does this imply, as we argue, that the individual will experience mood improvement (compared to baseline) right away, because the body requires more time to fully recover physiologically and to enter homeostasis (Gračanin et al., 2015). As shown in Figure 2, (4), arousal and negative valence will likely not have fully returned to baseline at crying offset. This explains why in laboratory studies participants typically report no mood improvement or even mood deterioration immediately after crying, but only after entering the post-crying phase (Gračanin et al., 2015). We also argue that once crying has subsided, the person will typically be more susceptible to initiating another crying episode since control may still be low, and the crying threshold more easily crossed when triggered by another or repeated stimulus exposure.

(5) Post-Crying Phase

After homeostasis is restored, the post-crying phase shows the same fluctuations in arousal and valence as the pre-crying phase [Figure 2, (5)]. Because energy is used to regulate excessive arousal, the individual's crying threshold may be lowered for a while after intense crying episodes.

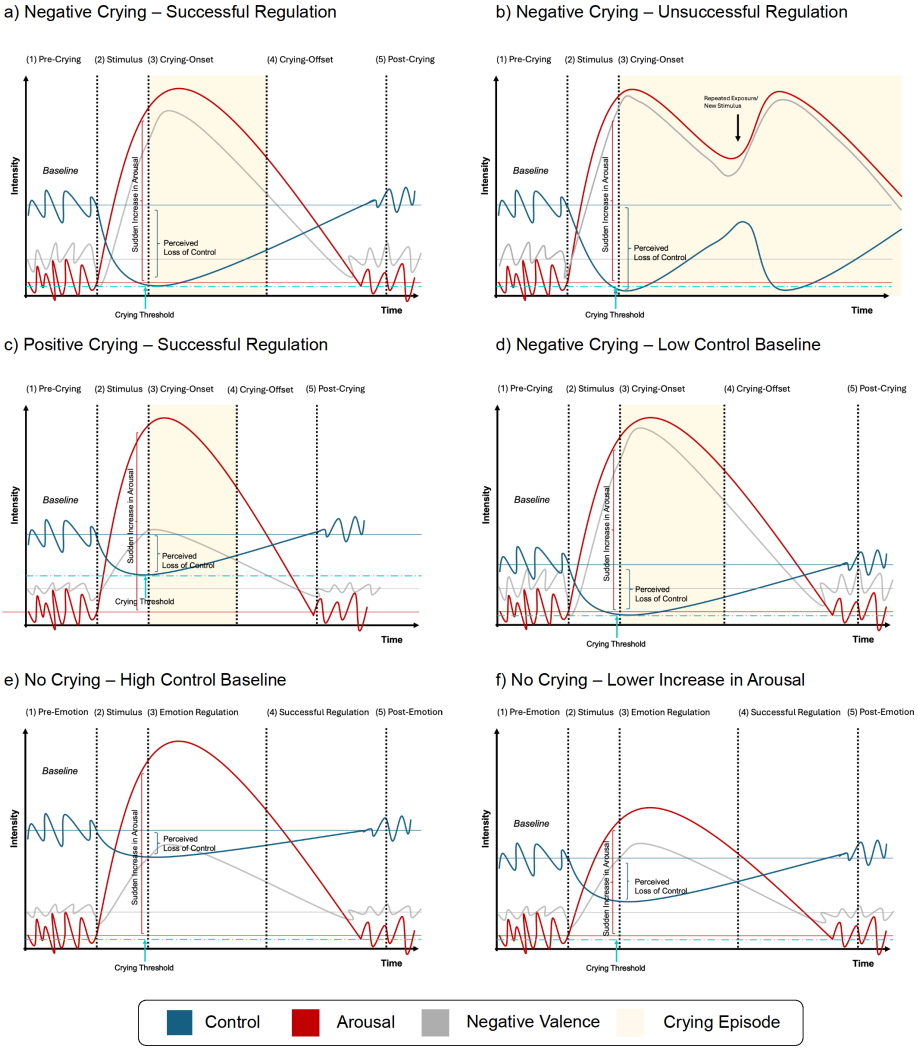
Application of the CAS

After introducing the main tenets of the CAS, its determinants, functions, and moderators, we now provide a simplified example of different predictions across different types of crying, as shown in Figure 3. First, Figure 3a illustrates the default trajectory of negative crying that is successfully regulated, either through signaling or intraindividual regulation (see Figure 3). The stimulus triggers an SIA and a PLC that crosses the crying threshold, resulting in a crying response. During crying, control is regained, and both arousal and negative affect are reduced. An example of the same situation with unsuccessful regulation is provided in Figure 3b. Here, a crying response is again initiated, but after a short reduction in arousal and negative affect and an increase in control, the PLC passes the crying threshold when the stimulus is repeated, or a new stimulus is presented. The crying episode remains unregulated. Figure 3c illustrates a positive crying episode. As discussed earlier, for positive crying, PLC is weaker than for negative crying, and the crying threshold is lower (i.e., less loss of control is needed to trigger crying). Reduced PLC also results in faster regulation of arousal, affect, and control, as well as a shorter (and less intense) crying episode. Since PLC is reduced, regaining control is easier, and intra-individual regulation may be sufficient. Figure 3d provides an example of a crier with a lower control baseline, suggesting that crying will be evoked more easily (as less PLC is needed to cross the crying threshold), but also that control may more easily return to baseline levels. A lower PLC with a constant SIA should result in a shorter, and most likely less intense, crying episode than in Figure 3a. However, this most likely depends on successful regulation by observers, as the crier's low control baseline makes it less likely that they can regain control themselves (e.g., more control may be needed to regulate crying than the individual has available at baseline).

In contrast, Figure 3e shows an example of someone with a high control baseline who requires a much larger PLC to reach the crying threshold. In this case, a PLC is not sufficient, and the same SIA as in previous cases can be more easily regulated without crying by using alternative regulatory strategies. Finally, Figure 3f illustrates a different situation that triggers less SIA and less PLC. Again, the crying threshold (assumed constant across cases) is not exceeded, and arousal, affect, and control can be regulated by other means. These examples provide only a snapshot of the variations that can explain crying. Given the extensive discussion on moderating factors in real-world applications, the specific relationships and trajectories will be more complex. The CAS is a first step toward a more integrative model of crying. In what follows, we will present specific testable predictions based on the CAS and discuss the model's limitations.

Figure 3

Overview of Different Scenarios as Predicted by the CAS



Note. (A) presents an example of successful regulation of negative crying. (B) focuses on the exact same levels of sudden increase in arousal and loss of control, but with unsuccessful regulation. (C) presents an example of positive crying with a lowered crying threshold and less intense crying. (D) provides an example of negative crying with a lower control baseline (and successful regulation). (E) provides an example of a high-control baseline and loss of control that does not exceed the crying threshold. (F) provides an example of lower increases in arousal (and reduced loss of control) that do not exceed the crying threshold.

Predictions and Future Research

Based on the model's theoretical foundation, we can derive several testable predictions. Some may already have empirical support, while others have not yet been subjected to empirical scrutiny, thereby generating hypotheses for future research. We hope that the CAS's main foundation will inspire other researchers to evaluate its claims, further expand it, or develop alternatives.

An overview of the main specific predictions is provided in Table 1. We differentiate the predictions by focusing on determinants and functions, as well as specific aspects related to the crying response, the crier, observers, the situation, or culture. Given the limited space, we present only a few examples of possible predictions. The model likely allows further predictions, especially given the complex interactions among determinants, functions, and moderators. We will highlight the main predictions, possible challenges, and avenues for future research below and refer to Table 1 for more details.

First, our model predicts that crying is triggered by the interaction of PLC and SIA. Few studies have measured both concepts, limiting direct evidence for the model's determinants. Importantly, future studies should assess both concepts using self-report and physiological measures. Another question pertains to the measurement of PLC. To validly quantify it, studies need to assess baseline levels of perceived control or continuously measure them before, during, and after the crying episode.

Second, according to the model, the interaction between PLC and SIA determines the intensity and duration of a crying episode. The higher the SIA and PLC, the more intense and longer-lasting a crying episode should be. Current evidence rarely investigates predictors of crying intensity or duration, instead focusing on variables that predict whether crying occurs in the first place (e.g., Barthelmäs et al., 2025) or whether it results in successful regulation (Rottenberg et al., 2008).

Third, as reviewed earlier, the determinants of crying are necessary but not sufficient. The actual occurrence of crying is determined by the crying threshold (and its relation to levels of control), which is determined by individual, situational, and cultural variables. Specifically, the model predicts that the crying threshold may vary not only between individuals, situations, and cultures, but also within them. A similar situation might not trigger crying in the same individual again due to some differences (e.g., observers present, changes in attitudes toward crying, feelings of shame, cultural display rules). Most research has focused on who cries, how often, and which variables determine crying frequency. To our knowledge, there is limited research on within-person variations in crying. Approaches such as diary studies or ambulatory assessment of crying within the same person over a longer period can address these questions (e.g., Bylsma et al., 2010).

Fourth, crying occurs more often among individuals with low baseline levels of control and low crying thresholds, since a PLC is more likely to cross a low crying threshold. Current research confirms that several personality variables moderate crying frequency (Gračanin et al., 2018). Future research needs to provide evidence that these variables are associated with lower levels of control. Similarly, crying occurs more often in situations with low baseline levels of control and a low crying threshold. In general, this means that negative situations, situations caused by others, uncontrollable circumstances, and times of day when control or the crying threshold is low (e.g., during the evening) should increase the likelihood of crying.

Fifth, although crying is widely associated with sadness or distress (Cordaro et al., 2016; Ito et al., 2019; Ong & Ito, 2022), the current model predicts that crying can occur with any emotion that features a PLC and SIA. This prediction is supported by current evidence that crying can occur across a broad range of emotions, including sadness, fear, anger, admiration, compassion, love, amusement, and awe (Barthelmäs et al., 2022; Gračanin et al., 2018; Zickfeld et al., 2020). However, there is limited research on the specific appraisals of such emotions, and further studies are needed to confirm whether the experience deviates from their stereotypical profile for crying (e.g., anger with crying is associated with reduced control compared to anger without crying).

Sixth, whether crying is beneficial depends on its two potential functions: whether it accurately signals a PLC and elicits social support, and whether intraindividual regulation is effective. The literature on when crying evokes social support has been growing recently and supports the model that individuals perceived as less assertive (i.e., less in control) are more likely to receive social support when their crying is also perceived as authentic and appropriate (MacArthur & Shields, 2019; Zickfeld & Wróbel, 2024). For intraindividual regulation, crying should be most effective if the PLC and SIA are reduced and people believe that crying can be helpful (e.g., a lower crying threshold). Lower PLC would make it easier for criers to regulate their arousal and mood. Studies on the regulation of arousal are typically limited to highly artificial settings involving negative crying, and, to our knowledge, no study on crying has yet tested whether social support can help regulate arousal using physiological measures.

Seventh, cultural factors that influence levels of control and the crying threshold should predict crying frequency, intensity, and duration. However, cross-cultural research on crying is still in its infancy, with limited variation observed across cultures (Becht & Vingerhoets, 2002; van Hemert et al., 2011; Zickfeld et al., 2021). Future studies should more systematically examine cultural variations in crying, its triggers, functions, and moderators.

Table 1.

Overview of Examples of Specific Predictions Derived From the CAS, Separated by Focus on Determinants and Functions, and Different Domains, Listing Current Evidence and Future Research Focus

Focus	Domain	Prediction	Current Evidence	Challenges/Future Research
Determinants	Crying Response	Crying is caused by the combination of PLC and SIA.	Meta-analysis on increased sympathetic activity at crying onset (Zickfeld & Grüning, 2021); Crying situations typically involve and trigger levels of overwhelmingness (Vingerhoets, 2013).	• PLC is less established for positive crying (Zickfeld et al., 2020) • Limited research on the interaction between PLC and SIA • Limited research measuring both physiological arousal and evaluations of control • Valid measurement of PLC needed
		The intensity and duration of crying are determined by the interaction between PLC and SIA	Intensity and duration of crying are lower for positive crying compared to negative crying, which is expected to include reduced PLC (Zickfeld et al., 2020).	• More direct systematic research investigating whether the interaction between PLC and SIA determines intensity and duration
		Crying onset is determined when the crier's level of control passes their crying threshold. It is offset once sufficient control is regained to enable crying regulation or other regulation strategies.	Various definitions of crying onset or offset are mostly based on self-report or observation (Gračanin & Vingerhoets, 2024)	• Systematic research assessing the onset of crying using a combination of self-report, observational, and physiological measures
		The crying threshold is related to the individual's level of control at which crying occurs and varies between and within individuals, situations, and cultures	Extensive evidence that individuals differ in crying proneness (Denckla et al., 2014), in the situations in which they cry (Vingerhoets, 2013), and in cultural contexts (Van Hemert et al., 2012).	• Less research on within-person variation in crying • Considering a valid measurement of control and moderator variables, the crying threshold should be able to be estimated

Table 1. – *Continued*

Focus	Domain	Prediction	Current Evidence	• Challenges/Future Research
Determinants	Crying Response	Any emotion that features the combination of PLC and SIA can include crying	Broad evidence that crying accompanies a range of emotions from negative (e.g., sadness, anger, fear) to positive (e.g., admiration, pride, love, awe, amusement; Zickfeld et al., 2020; Vingerhoets, 2013). Nevertheless, crying is stereotypically associated with sadness (e.g., Ito et al., 2019)	• More systematic research is needed of emotions and situations associated with crying across the lifespan • Especially large gap for crying in adolescence; emergence of positive crying
		Crying most frequently accompanies emotions that are lower in control and high in arousal.	Specific differences exist between sadness without crying and sadness with crying, considering different levels of arousal (Kreibig, 2010). Anger-related crying is more commonly associated with lower control (Fischer & Evers, 2010).	• Conduct more research on differences in emotions' specific and general profiles (e.g., sadness typically accompanied by low arousal, but arousal is higher for situations involving crying) • Research whether crying is possible for high control/low arousal emotions, such as contentment or interest
	Crier	Crying should occur more frequently in individuals with low in baseline levels of control	Extensive evidence that crying is most frequent in individuals with lower levels of control (e.g., infants), associated with personality traits related to lower levels of control (e.g., neuroticism, mental health problems; Barthelmäs et al., 2025) or situations with lower levels of control (e.g., end of the day).	• Limited direct evidence that reducing levels of control makes individuals more likely to cry
		Crying should occur less frequently in individuals with difficulties reacting to emotional events with increased arousal	Some evidence that disorders characterized by reduced emotional reactivity (e.g., major depressive disorder) include less sympathetic activation (Rottenberg et al., 2002). Negative association between alexithymia, related to deficits in interpreting arousal (Peasley-Miklus et al., 2016), and crying frequency (Vingerhoets et al., 1993; Zickfeld et al., 2022).	• More direct research is needed to determine whether differences in crying for these conditions are related to emotional reactivity or arousal, instead of other third variables

Table 1. – *Continued*

Focus	Domain	Prediction	Current Evidence	• Challenges/Future Research
Determinants	Situation	Crying should occur more frequently and intensely in situations in which the situation is not caused by the crier or is under low control	Some evidence that most crying episodes are not caused by the crier (Bylsma et al., 2008), but limited evidence for association with frequency or intensity.	• More systematic research is needed on situations varying in levels of control and their association with crying frequency and intensity
	Culture	Cultural variables influencing levels of control or the crying threshold predict crying, but will most likely interact with situational appropriateness	Limited research on cultural differences in crying. One study found that respondents reported more frequent crying in more extraverted, individualistic, and democratic countries, linking it to freedom of speech (Van Hemert et al., 2011), but the study is also limited by its variation on those features (sampling mostly Western/European countries).	• More systematic research is needed on cultural differences in crying needed (e.g., importance of emotional expressivity, Masculinity-Femininity, honor cultures, power distance)
Functions	Crying Response	High intensity and longer crying should result in less successful regulation	Some evidence that high intensity crying might elicit aversive reactions due to anger or frustration (Levitzky & Cooper, 2000). High-intensity, exaggerated crying responses are typically perceived as less genuine and considered fake crying, especially when tears are absent (Wróbel et al., 2025c). Duration and intensity are negatively related to improvement of physical well-being (Bylsma et al., 2008). Positive crying that is less intense typically results in improved regulation (Zickfeld et al., 2020)	• More research is needed on the possible non-linear relationship between intensity/duration and successful regulation across the lifespan • Role of excessive crying (e.g., infant colic, pathological crying) and regulation
		The combination of PLC, SIA, and baseline level of control determines how easily crying can be regulated. Higher SIA, PLC, and lower baseline control should predict worse regulation.	-	• More research is needed on the possible non-linear relationship between intensity/duration and successful regulation across the lifespan

Table 1. – *Continued*

Focus	Domain	Prediction	Current Evidence	• Challenges/Future Research
Functions	Crier	The individual's crying threshold for similar situations will be determined based on the successful regulation of crying	Indirect evidence that individuals intentionally upregulate their crying response and lower their crying threshold based on attitudes and experiences (Sharman, Dingle, & Vanmen, 2019; Simons et al., 2013).	• More research on the between and within variation of an individual's crying threshold and how it is determined by experiences of previous crying (or attitudes)
	Situation	Situations featuring reduced PLC should determine the success of regulation in the absence of social support.	Evidence that positive crying is more easily regulated without social support (Ishii & Shinya, 2021; Rottenberg et al., 2008; Zickfeld et al., 2020).	• Research should systematically study varying situations and assess PLC and successful regulation to further verify this prediction
	Culture	Cultural variables influencing social support, PLC, and crying threshold should predict successful regulation.	Evidence suggests that crying occurs more often in affluent and democratic countries (Van Hemert et al., 2011), and support intentions are higher for those country-level variables (Zickfeld et al., 2021)	• How to reconcile the findings that crying and support are more common in more individualistic and Western countries with the prediction that collectivism and lower control predict crying and support. • More systematic research on cultural differences in crying is needed (e.g., is regulation more effective in more individualistic cultures?)

Limitations

Given the CAS model's attempt to accommodate all instances of human crying, there are natural limitations that need to be addressed, which often also extend to the current literature on crying.

First, crying research has suffered from limited standardization across protocols and studies regarding the measurement and definition of crying (Gračanin & Vingerhoets, 2024; Vingerhoets, 2013). The current model provides greater specificity regarding the onset and offset of crying (related to the individual's crying threshold) but does not offer standardized criteria that are easy to implement in studies. Future studies should expand on the current model and develop standardized multimodal measures including self-report, observation, and physiological measures to validly operationalize crying. Future studies should systematically test the causal roles of PLC and SIA, as current evidence, especially for SIA, is mainly correlational (Zickfeld & Grüning, 2021).

Second, the model is also limited by the lack of causal research on the effects of crying, since inducing crying in controlled settings is both practically and ethically challenging. Most laboratory studies on crying use quasi-experimental designs that compare individuals who report crying with those who do not. More systematic real-world approaches, including diary studies, momentary assessment, and ambulatory physiological measurement, are necessary to provide a more valid test of crying.

Third, while the current model provides a parsimonious approach to crying, its main tenet is the interaction between PLC and SIA, which may be oversimplified in more complex situations. Importantly, we emphasize that neither determinant is sufficient to evoke crying and that both depend on a range of individual, situational, and cultural moderators. We have provided a snapshot of the most-studied moderators, but future studies may identify additional moderators that enhance the model's explanatory power.

Fourth, drawing on evolutionary evidence, the model argues that signaling a loss of control is the main function in both childhood and adulthood. While there is extensive evidence that this signaling function persists into adulthood (Zickfeld & Wróbel, 2024), the model places less emphasis on self-regulatory intraindividual functions. We acknowledge that research on intraindividual regulation does not provide coherent evidence favoring one mechanism over another. According to our review, oxytocin, rhythmic sobbing, and additional emotion regulation are the most promising candidates. However, other cognitive mechanisms, such as reflection or meaning-making (Paoli et al., 2022), may also be potential candidates, and future research should study them more systematically.

Fifth, while we emphasize the importance of cultural moderators in understanding the determinants and functions of crying, there is limited evidence on cross-cultural differences, and most research is based on Western samples (Muthukrishna et al., 2020), thereby limiting culturally specific predictions. Future

studies should test the CAS across diverse cultural contexts to validate its main predictions and identify additional cultural moderators.

Sixth, the model aims to provide a general approach to crying across the lifespan. However, due to its parsimony, it might fall short in identifying specific developmental stages or mechanisms that reflect changes in crying. For example, why and when do children start crying in positive situations, and how does the model predict these changes? We speculate that such differences are related to the emergence of morality, the development of empathic skills, and higher levels of control, but the model could be more specific about the exact developmental trajectories. Future studies would need to verify the main processes of the CAS across the lifespan by providing longitudinal evidence.

Seventh, the current model mostly ignores the impact of neurological processes. While we believe that neurophysiological processes are important for crying, we refrain from speculating about their role due to the limited evidence available (Bylsma et al., 2019; but see research on pathological crying, Wortzel et al., 2008). Given the accumulated evidence on the roles of somatic activity and cognitive processes, we focus on these aspects. Naturally, future versions of the model should be updated to incorporate new evidence or informed predictions regarding the role of neurological processes.

Eighth, like many theories in psychology (Lange et al., 2025), the current model is descriptive, and its specificity could be improved by formalizing its main tenets (see Jafari & Anbarjafari, 2026, for a recent example).

Conclusion

Based on an extensive review of the literature on emotional crying, its determinants, functions, and moderators, we present an integrative biopsychosocial model, the Control-Arousal Signal Model (CAS). We argue that emotional crying results from the interaction between a sudden increase in arousal and perceived loss of control, and functions as a signal to communicate loss of control and to elicit social support, and, once the individual develops greater independence, also serves as an intra-individual mechanism for regulating arousal and mood. We identify individual, situational, and cultural moderators that influence both the occurrence of crying and its successful outcome. This model provides an initial step toward an integrative summary of theoretical and empirical evidence and, hopefully, advances theoretical study by solving the often-claimed *riddle* of emotional crying.

Author Contribution Statement. Janis H. R. Zickfeld: Conceptualization, Methodology, Visualization, Project administration, Writing – Original draft; **David J. Grüning:** Conceptualization, Writing – Review & Editing.

Data Availability Statement. Supplemental material is available at https://osf.io/hg4zr. A more detailed version is available at https://osf.io/preprints/psyarxiv/pbdvu_v2. Supplemental material is also available on the journal's website (https://pt.ffri.hr/pt/issue/view/52).

Notes

[1] We consider shedding emotional tears sufficient to define an episode of crying, but not necessary (e.g., newborns do not shed emotional tears during their first weeks; Vingerhoets, 2013). Distress vocalizations can be sufficient to be considered crying, serving to communicate a loss of control, but they are not necessary (e.g., individuals can shed tears without vocalizations). Not all vocalizations are considered indicative of crying. For instance, vocalizations of anger intended to communicate frustration or dissatisfaction (Kerr & Schneider, 2008) would not be considered crying. Finally, the combination of facial muscle contractions defined above is sufficient to consider an episode of crying, but not necessary (e.g., shedding tears while restraining facial expressions). Importantly, a single facial muscle contraction is not sufficient for an episode to be classified as crying, and facial expressions may already be triggered before the crying episode (Bylsma et al., 2019). Different expressions follow a temporal sequence: the crier often first shows facial muscle contractions or vocalizations, followed later by emotional tears, but there is no fixed sequence that defines an expression as crying.

[2] For instance, is the stimulus always triggering the cognitive component first (e.g., an appraisal), which then causes somatic changes, or can changes in somatic activity influence cognitive evaluations? Appraisal theories place the cognitive component prominently before the somatic component, but in the current model, the exact causal relationship is of minor interest and subject to empirical testing. Therefore, we cannot exclude the possibility that the cognitive component precedes the somatic component, that they occur simultaneously, or that they reinforce each other in a type of feedback loop (similar to causal network theories of emotion; Lange & Zickfeld, 2023). Similarly, it is not important whether the feeling component causes the motivational and emotion-regulation components, or vice versa. What is crucial is that they precede crying.

[3] Note that while the model posits that crying is caused by a perceived loss of control (PLC), it does not necessarily mean that the individual will always be low in control as a result (see valence of the situation as a moderator; Figure 3). Surveys have found that individuals report strategically upregulating their crying, which is not incompatible with the idea of PLC (Simons et al., 2013)

[4] Different types of *control* have been considered, including control attributed to oneself (e.g., crying because of a great achievement), another person (e.g., crying because your partner broke up with you), or circumstances (e.g., crying because you lost someone in a natural disaster; Ellsworth & Scherer, 2003). Further, *control* has been distinguished as *retrospective* (i.e., controlling the stimulus that triggers the emotion) and *prospective* (i.e., controlling the consequences; Ellsworth & Scherer, 2003). We consider any type of perceived loss of control (e.g., attributed to the self, another person, or circumstances; retrospective or prospective) relevant to crying, but acknowledge that the strength may differ across forms.

[5] Appraisal theories have suggested a range of relevant appraisal dimensions (Ellsworth & Scherer, 2003; Scherer & Moors, 2019), including novelty or goal-relevance, agency or intentionality, valence, control (or power), and fairness. According to the current model, a perceived loss of control (PLC) is necessary, while the relevance of other appraisal dimensions may depend on stimulus, situational, or individual factors. For instance, while novelty can be important, research shows that individuals may cry repeatedly for the same piece of music (Hanser et al., 2022). In terms of agency, crying situations are often reported to be caused by other individuals or situational circumstances (Bylsma et al., 2008). The valence of situations eliciting crying can range from negative to positive (Zickfeld et al., 2020).

[6] Importantly, some components, such as facial expressions, can occur faster than peaks in sympathetic arousal (He et al., 2014), and it is possible that facial muscle contractions already appear before excessive arousal is manifested. This might also involve facial muscles commonly associated with crying, but this does not necessarily mean that a crying episode will begin just because a few facial muscles contract. In addition, arousal may further increase after the onset of crying (Gross et al., 1994). SIA is important in determining crying, but may not be at its peak during onset (see Figure 2).

[7] Importantly, individuals may also upregulate their crying threshold to cry more easily (Simons et al., 2013) for many reasons, such as believing that crying can be beneficial (see the section on attitudes toward crying) or to manipulate observers (Wróbel et al., 2025c).

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