

Chapter 1

Emotion Duration



Philippe Verduyn 

Abstract Emotions are processes that unfold over time. This implies that research on dynamic features of emotions is needed to understand how emotions operate. One key dynamic feature is emotion duration. For a long time, no research on emotion duration was conducted. However, during the last three decades, our understanding of emotion duration increased significantly. In the present chapter, I provide an overview of research on emotion duration. First, I define emotion duration and discuss the conceptual complexities surrounding the start and end of an emotional episode. Next, I describe studies that examined how long emotional episodes last. These studies converged on the conclusion that emotion duration is highly variable with episodes lasting for seconds, minutes, hours or even longer. Subsequently, I review research examining the mechanisms underlying emotion duration. These mechanisms include psychological processes that occur at the start of an emotional episode, as the initial appraisal of an emotion-eliciting event and intensity of the emotional response are major determinants of emotion duration. Moreover, emotion duration also depends on psychological processes that unfold during the emotional episode as dynamics in attention, appraisals and regulation strategies prolong or shorten emotional episodes. The chapter ends with directions for future research.

Keywords Emotion duration · Definition · Determinants · Mechanisms · Attention · Appraisals

1.1 Introduction

Emotions are not stable states but are constantly in flux. This implies that research on the dynamic properties of emotions is necessary to understand how they operate. However, for a long time research on emotion dynamics was scarce (Frijda, 2007).

P. Verduyn (✉)

Faculty of Psychology and Neuroscience, Maastricht University, Maastricht, Netherlands

e-mail: philippe.verduyn@maastrichtuniversity.nl

Researchers studied the processes underlying the onset of an emotional response but paid little attention to how emotions subsequently unfold over time.

This situation changed from the nineties onwards when researchers started to examine emotion dynamics, inspired by the pioneering work of Davidson (Davidson, 1998), Frijda (Frijda et al., 1991) and Scherer (Scherer & Wallbott, 1994), amongst others. This increase in research efforts resulted in a better understanding of the dynamic properties of emotions due to which the research field of emotion dynamics is one of the most enticing research fields within affective science today.

Research on emotion dynamics pertains to the study of the trajectories, patterns, and regularities with which emotions or their components (i.e., the experiential, physiological, and behavioural components) fluctuate across time. Researchers operating in this field do not only describe these temporal changes but also examine underlying processes and downstream consequences of these changes (Kuppens & Verduyn, 2015). To measure emotion trajectories, a wide range of tools are available. Each tool has its own advantages and disadvantages as illustrated by two common methods to measure trajectories of emotional experience: the experience sampling approach and the intensity profile approach.

Experience sampling entails asking participants multiple times per day to report on how they feel (e.g., how sad do you feel right now?) during the period following a particular emotional event (e.g., Villano et al., 2020) or during a random segment of a participant's life (e.g., Brans et al., 2013). A key advantage of this approach is that memory bias is minimal but the resulting data is discrete and short-term changes in emotional experience may go by unnoticed.

The intensity profile approach entails asking participants to draw intensity profiles of their emotional experiences (Sonnemans & Frijda, 1994). The resulting data are continuous but memory bias may influence the collected data when reporting on past emotional experiences (e.g., Verduyn et al., 2009b). To avoid this, one may ask people to draw profiles while experiencing an emotion (e.g., Hutcherson et al., 2005) but this approach cannot be adopted outside the lab.

To describe variability in emotion trajectories, a wide range of features have been proposed and studied (for an overview, see Kuppens & Verduyn, 2015). Among these, one key feature is the duration of emotions. The importance of this particular feature is reflected by the observation that people sharing their emotions do not only often spontaneously describe the nature (e.g., I was *angry* at him) and intensity (e.g., I was *very angry* at him) but also the duration of their emotions (I was very angry at him *all day long*). Moreover, the duration of emotional episodes has major consequences for physical and mental health (Lapate & Heller, 2020).

The aim of this chapter is to provide an overview of research on emotion duration building on previous reviews of literature on this dynamic feature (Van Mechelen et al., 2013; Verduyn et al., 2015). Specifically, I will first define emotion duration. Next, I will review empirical evidence on how long emotions tend to last. Subsequently, I will illustrate that the duration of emotions is not only determined by events that take place at the start of an emotional episode but also by processes that unfold during an emotional episode. Finally, I will end this chapter by providing some suggestions for future research followed by a concluding statement.

1.2 What Is the Definition of Emotion Duration?

Emotion trajectories reflect the continuous level of a particular emotion or emotion component over time. Typically, these trajectories show fluctuations. For example, when people are asked to report their level of anger repeatedly throughout the day, the resulting trajectory is unlikely to be a flat line. A wide range of factors causes these fluctuations to take place including biological rhythms, sleeping patterns or (insufficient) food intake. However, major shifts in emotion trajectories are often due to the occurrence of particular events, which initiate the start of so-called emotional episodes (Kuppens & Verduyn, 2015).

Emotion duration refers to the duration of emotional episodes. Specifically, the duration of an emotional episode refers to the amount of time between the start and end of an emotional episode (Verduyn et al., 2015). The start of an emotional episode corresponds with the occurrence of a particular event which is relevant for one's goals or concerns (Frijda, 2007). This differentiates emotional episodes from moods, which do not have a clear cause or object (Beedie et al., 2005). It should be noted that the emotion eliciting event can be an external event (e.g., seeing a spider) but also an internal event as when imagining, recalling or anticipating events (e.g., thinking of a spider). Moreover, when thinking about external future events, an emotional episode can start before the external event takes place. For example, an emotional episode of anxiety typically does not start when giving a speech but rather when starting to anticipate having to give a speech.

The end of an emotional episode is more difficult to delineate than the onset. Overall, two different conceptualizations can be distinguished. First, the end of an emotional episode can be equated with the first point in time at which emotion intensity reaches zero or, similarly, returns to a baseline level (Verduyn et al., 2009a, 2011, 2012b). An advantage of this conceptualization is that it is relatively straightforward to determine when an emotional episode ends, which allows studying emotion duration empirically in a relatively straightforward manner. A disadvantage, however, is that this conceptualization does not take into account that emotions may be re-elicited after having returned to their baseline level. For example, following an insult an episode of anger may be initiated. This feeling may persist until running into a friend with whom one has a pleasant conversation during which anger is no longer felt. The start of this conversation therefore constitutes the end of the emotional episode of anger. However, once the conversation is over, one may immediately recall the insult and feel angry again. When equating the end of an emotional episode with a first return to baseline, the moment of recalling the insult following the conversation would be conceptualized as the start of a totally new emotional episode, while, in fact, it is directly related to the preceding anger episode.

Second, the end of an emotional episode can be equated with the moment in time at which the episode is "closed" in the sense that the emotion intensity associated with an emotion-eliciting event reaches zero (or baseline) in a permanent manner (Frijda et al., 1991; Frijda, 2007). Closure is reflected by a lack of spontaneous recollections of the emotional event and a lack of emotional reactivity in those rare cases the emotional event would be recollected. This may be accompanied by

decreased emotional detail in the autobiographical memory representation of the emotion-eliciting event (Beike & Wirth-Beaumont, 2005). For example, following an insult one may experience anger for several days. This experience of anger may be temporarily interrupted by several periods during which one feels calm but only when an apology is received, the emotional episode may be fully closed.

An advantage of this conceptualization is that it distinguishes temporary relief (i.e., a temporary non-stable return of emotion intensity to zero) from stable emotional recovery (i.e., a stable return of emotion intensity to zero) (Frijda, 2007). However, it is often hard to say when an emotional episode is fully closed and some emotional episodes may never end according to this conceptualization, making it especially hard to study emotion duration at an empirical level.

1.3 How Long Do Emotions Last?

For a long time, it was believed that emotional episodes only last for seconds up to a few minutes at most (Ekman, 1984). This belief was largely based on animal models of emotion (Darwin, 1965) and observations of the duration of emotional expressions in the lab (Ekman & Friesen, 1982). However, animal models and lab data on emotion expression do not represent particularly well how long an emotion can last (Frijda, 2007; Rimé, 2009). Several lines of research indicate that typically emotions last longer than a few seconds or minutes.

First of all, while activation in the behavioral or expressive component of emotional responses may be shorter than activation in the other components of an emotional response, some data is available suggesting that even activation in emotional expression may last longer than just a few minutes (Bylsma et al., 2011). Moreover, while data on physiological recovery observed in the lab is generally consistent with the notion of emotions lasting for a few minutes only (e.g., Fredrickson & Levenson, 1998), data on cardiovascular recovery following stressful events in daily life, reveal significantly longer recovery periods (Pieper & Brosschot, 2005). Furthermore, data on the duration of the conscious emotional experience component of an emotional response show convincingly that these experiences typically do not end within a few minutes only.

Most studies on emotion duration have focused on the duration of emotional experience as obtained through self-report questionnaires. In these studies the end of an emotional episode was either not explicitly defined to the participants (e.g., Scherer & Wallbott, 1994) or defined to occur when emotion intensity returned to zero or a baseline level for the first time (e.g., Verduyn et al., 2009a), which corresponds to the first conceptualization mentioned above. Research explicitly using the second conceptualization (permanent return to baseline) is rare, but non-surprisingly, participants reported longer emotions when the end of an emotional episode was defined to them to correspond to a permanent return to baseline, rather than a first return (Verduyn & Lavrijsen, 2015).

Critically, regardless of the duration definition employed, it was found that emotional experiences can last for seconds but usually these experiences last longer. Specifically, the duration of emotional experiences was found to be highly variable with durations ranging from a few seconds to several hours, or even longer. Moreover, in each study on the duration of emotional experiences in daily life, duration averages clearly exceeded a few minutes (Frijda et al., 1991; Gilboa & Revelle, 1994; Scherer & Wallbott, 1994; Verduyn et al., 2009a, 2011, 2012a, b, 2013).

While most people tend to experience emotions that often last longer than only a few minutes, certain people tend to experience longer emotions than others do. At the level of socio-demographic factors, evidence is available that older adults experience longer positive emotions and shorter negative emotions than younger adults (Charles et al., 2016). Moreover, negative emotions were found to last longer in collectivistic and poorer countries than in individualistic and rich countries, respectively (Verduyn et al., 2013). At the level of personality dimensions, extraverts were found to tend to experience longer positive emotions than their introvert counterparts (Verduyn & Brans, 2012), while neurotics experience longer negative emotions than their emotionally stable counterparts (Schuyler et al., 2012; Verduyn & Brans, 2012). At the level of indicators of mental health, resilient people were found to show accelerated recovery from stressful encounters (Tugade & Fredrickson, 2004). This should not come as a surprise as resilience refers to the ability to cope effectively and adapt in the face of loss, hardship, or adversity (Block & Kremen, 1996). Moreover, consistent with diagnostic criteria, depressed individuals were found to be unable to sustain activity in neural circuits underlying positive affect (Heller et al., 2009) while showing longer activation in neural regions associated with negative emotions (Siegle et al., 2001, 2002).

It is not only the case that some people tend to experience longer emotions than others do but also some types of emotions tend to last longer than other types of emotions. Several studies have been conducted to compare the duration of different emotions and the results of these studies largely overlap (Gilboa & Revelle, 1994; Scherer & Wallbott, 1994; Verduyn et al., 2009a, 2011, 2012a, b). The largest set of emotions was studied by Verduyn and Lavrijsen (2015). They found that out of 27 emotions, sadness lasted the longest, whereas shame, surprise, fear, disgust, boredom, being touched, irritation, and relief were the shortest emotions. In some cases, the size of differences was quite remarkable with sadness lasting on average 240 times longer than the shortest emotions under study but in most cases duration differences were much smaller.

In sum, emotions can last for only a few seconds but usually last for minutes, hours or even longer. However, why do some people tend to experience longer emotions than others do? Why do certain types of emotions tend to last longer than other types of emotions? Moreover, what causes differences in duration between two episodes of the same type of emotion, experienced by the same person? These questions bring us to the next section where I discuss determinants of emotion duration.

1.4 What Determines the Duration of an Emotion?

1.4.1 *What Happens at the Start Impacts How Long It Takes to Get to the End*

By definition, an emotional episode is initiated by the occurrence of an internal or external event. The perceived nature of this event has a major impact on the duration of the ensuing emotional response. In several studies, it was found that the perceived importance of the emotion-eliciting event partially explains duration variability *within emotions*. Specifically, events of higher perceived importance are associated with longer emotional episodes (Verduyn et al., 2009b, 2011). Moreover, compared to short types of emotions such as disgust, relatively long lasting emotions such as sadness are caused by events that are higher in importance. As such, perceived event importance also partially explains duration differences *between emotions* (Verduyn & Lavrijsen, 2015).

Events may be perceived as important because they are especially congruent (in case of positive emotions) or incongruent (in case of negative emotions) with one's goals, norms, values or self-ideals (Frijda, 2007). In the context of negative emotions, it has been shown that the number of perceived mismatches between an event and one's desires predicts the duration of negative emotional experiences and this mismatch-duration mechanism was found to largely hold universally (Verduyn et al., 2013). More recently, it has been shown that the degree to which an event matches one's expectations also impacts the ensuing emotional trajectory (Villano et al., 2020).

However, the duration of an emotional response is not only a function of the (initial) appraisal of an emotional event but also of the initial intensity of an emotional episode. This is the case even when controlling for the perceived importance of an emotional event, which suggests that the role of intensity in predicting duration cannot be fully explained by event importance (Verduyn et al., 2009a, 2011, 2013). When intensity is high at the start of an emotional episode, it takes longer for emotional experience to return to its baseline level. Critically, however, this does not imply that emotional episodes are always, or even typically, characterized by a high intensity peak at the start followed by a gradual return to baseline (Heylen et al., 2015, 2016).

In research using an intensity profile approach to measure trajectories of emotional experience, it was found that such trajectories can take a wide variety of shapes (Sonnemans & Frijda, 1994). Moreover, these intensity trajectories were found to differ primarily in explosiveness, accumulation, and reactivation (Verduyn et al., 2009b, 2012a). Intensity profiles can have (a) a low or high level of initial intensity, reflecting differences in explosiveness, (b) a peak intensity level situated at the start or end of the episode, reflecting differences in accumulation, and (c) a single or multiple intensity peaks, reflecting differences in reactivation. The distinct nature of these dynamic features is corroborated by fMRI studies on the neural correlates of explosiveness and accumulation showing distinctive neural correlates for both features (R sibois et al., 2017, 2018b).

In sum, the degree of mismatch between the event and one's desires as well as the initial intensity of an emotional response impact the duration of an emotional episode. Moreover, the recovery process is not always a linear process characterized by a gradual, uninterrupted return to baseline. Regardless, the emotion-eliciting event sets the stage for the subsequent processes that will unfold over time and that impact the duration of the emotional response, which I turn to in the next section.

1.4.2 Time Itself Does Not Heal All Wounds; What Happens Over Time Matters

A common expression is that time heals all wounds. While this expression may seem correct at the surface level, it raises several questions. For example, is it true that eventually all emotions end? Do feelings of sadness following a major emotional event such as the loss of a child ever return to their baseline level in a stable manner (see second conceptualization of the end of an emotional episode above). Perhaps even more critically, what does it mean to say that time heals all wounds. Does the passage of time automatically result in an emotion running out of steam, like a car having no fuel left to keep driving? While metaphors like this might be intuitively appealing, the construct of time in and of itself does not explain changes in emotions over time. Instead, emotion dynamics are a function of temporal changes in mechanisms that drive emotional responding. In the next paragraph, I discuss two processes that can change with the passage of time and impact the duration of emotional episodes. This is not to say that there are no other dynamic processes that may impact the duration of emotional episodes but these two processes have received substantial empirical evidence.

1.4.2.1 The Role of Attention

An emotion-eliciting event continues to affect the unfolding of an emotional episode during the period following emotion elicitation. In a diary study, Verduyn and colleagues (Verduyn et al., 2009a) asked participants to recall the duration of their emotional episodes experienced earlier that day. For each 15-min interval of the emotional episode, they also asked participants to indicate whether the emotion-eliciting stimulus was physically present or absent. For example, when having an argument, the emotion-eliciting stimulus (i.e., another person) may be present during the first 15 min, leave the room for the next 15 min (possibly slamming the door on the way out), and return back (or not) in the next 15 min. It was found that the physical presence or reappearances of an emotion-eliciting event make it less likely that an emotional episode ends.

In a second, similar study (Verduyn et al., 2009a), the authors examined whether the mental presence of the eliciting stimulus (thinking about the emotion-eliciting event) similarly impacts the duration of an emotional episode. They found this to be

the case with the mental presence or mental reappearances of the emotion-eliciting event prolonging emotional episodes. Interestingly, follow-up research revealed that physical and mental reappearances may prolong emotional experiences by causing reactivations (new peaks) within an emotional episode (Verduyn et al., 2012a).

Combined, these results suggest that one key mechanism, which varies over time and influences the duration of emotional responses, is attention. The physical presence of an emotion-eliciting stimulus likely prevents one from diverting attention elsewhere. Similarly, when the eliciting stimulus is mentally present, attention is by definition focused on that particular stimulus. Attention may also explain the connection between (initial) emotion intensity and emotion duration with fMRI research revealing a relationship between intensity and longer duration of activation in regions along the cortical midline associated with self-referent processing (Vaughn et al., 2010). Similarly, from a functional perspective on emotions (Keltner & Gross, 1999) one may argue that important events that are especially congruent or incongruent with one's desires require one's attention for a longer time, identifying a possible mechanism explaining the relationship between perceived event importance and emotion duration.

The claim that attention is a major determinant of the duration of emotional responses is consistent with research on emotion regulation. Specifically, it has been shown that distraction (i.e., directing attention away from an emotion-eliciting event) generally reduces the intensity of negative emotions (Fennell et al., 1987; Joormann & Siemer, 2004) while rumination (i.e., excessively focusing attention on the causes and consequences of an emotion-eliciting event) has the opposite effect (Nolen-Hoeksema & Morrow, 1993). Attention has also been shown to explain why long lasting emotions such as sadness tend to last longer than other types of emotions, as long lasting emotions tend to be associated with relatively high levels of rumination (Verduyn & Lavrijsen, 2015). Similarly, neurotics may tend to experience long negative emotions, due to their tendency to ruminate over negative experiences (Nolan et al., 1998).

In some recent work, the relationship between attention and emotion duration was examined even more directly. Freund and Keil (2013) proposed the attention-focus hypothesis according to which the duration of an emotional response to events is crucially determined by the amount of attention they receive. In a first study, they instructed participants to focus attention on an event that recently caused them to experience a positive emotion (having won a chess game) or to focus their attention elsewhere. In a second study, they used a similar experimental design but this time in the context of negative emotions. In both studies, they found that distracting attention away from the emotion-eliciting event leads to a shorter duration of an emotional experience. Consistently, Kaneko et al. (2018) conducted a cross-sectional study and found a positive relationship between attention and the duration of both negative and positive emotions.

A wide variety of factors may influence people's attention during an emotional episode. These include the occurrence of novel events that automatically redirect people's focus elsewhere as well as people's own conscious attempts to direct their focus. One particular interesting emotion regulation strategy that may cause people

to sustain their attention on the emotional event is social sharing. Research on social sharing showed that people share their emotions with others in the large majority of cases (Rimé et al., 1998). In case of positive emotions, it has been shown that sharing is associated with longer episodes of positive emotion and more time spent thinking about the positive event (Hovasapian & Levine, 2018). However, in case of negative emotions results on the impact of social sharing on episode duration are less clear-cut (Brans et al., 2014; Pe et al., 2013; Rimé, 2009).

In sum, previous research indicates that focusing attention on an emotion-eliciting event is generally positively associated with the duration of emotional experience while distraction shortens emotional episodes. However, three critical remarks are needed to nuance this conclusion. First, not all types of distraction shorten emotional episodes. In contrast to positive distracting thoughts, negative distracting thoughts do not shorten the duration of negative emotions. Similarly, in contrast to negative distracting thoughts, positive distracting thoughts do not shorten the duration of positive emotions (Verduyn et al., 2011). Second, the effects of distraction may be short-lived. Distraction may shut down an emotional episode temporarily as reflected by a first return of emotion intensity to a baseline level (first conceptualization of the end of an emotional episode mentioned above). However, this return might reflect a state of temporary relief rather than stable emotional recovery (second conceptualization of the end of an emotional episode mentioned above) (Kross & Ayduk, 2008). Third, while focusing attention on an emotional episode may generally prolong emotional episodes, it may also shorten emotional episodes as explained in the next section.

1.4.2.2 The Role of Appraisal Dynamics

To examine whether all types of mental reappearances prolong the duration of emotional experiences, Verduyn and colleagues conducted a follow-up study (Verduyn et al., 2011). Similarly to their original study (Verduyn et al., 2009a), they used a diary design asking participants to recollect the emotions they experienced earlier that day. However, rather than asking participants to indicate for several time-segments of the emotional episode whether the emotion-eliciting stimulus was mentally present or not, they asked participants to specify the valence of their thoughts about the emotion-eliciting stimulus. They found that during negative emotional episodes, participants reported most often negative thoughts about the emotion-eliciting event and these thoughts (e.g., “he really enjoys hurting me”) prolonged negative emotional episodes. Critically, however, when people had positive thoughts about the negative emotion-eliciting event (e.g., “he probably did not mean it that way”), this increased the probability that a negative emotional episode would end at that moment in time. In case of positive emotions a similar pattern was found with positive (negative) thoughts about the emotion-eliciting event prolonging (shortening) the emotional episode.

The finding that during negative (positive) emotional episodes people tend to have negative (positive) thoughts about the emotion-eliciting event may explain why mental reappearances of this event (or focusing attention on this event) were

overall found to have a prolonging effect on the duration of emotional experience (Verduyn et al., 2009a). Moreover, the finding that thoughts about the emotion-eliciting event prolong emotional experiences when they share valence, is consistent with research on social sharing of positive emotions showing that the association between sharing and emotion duration was greatest when sharing partners were perceived as highlighting the importance and remarkability of the event, “keeping the magic alive” (Hovasapian & Levine, 2018).

The finding that positive thoughts shorten the duration of negative emotions is consistent with research on positive reappraisal (i.e., reappraising a negative event in a more positive manner). In a wide range of studies, this emotion regulation strategy has been shown to be highly effective at downregulating negative emotional responses (Gross, 1998a, b; Ray et al., 2008), and stimulating emotional recovery over time (Mehta et al., 2020). However, research on contextualized emotion regulation revealed important boundary conditions of the generally adaptive effects of reappraisal (Aldao, 2013).

For example, when people experience intense negative emotions, they are unlikely to engage in reappraisal (Sheppes & Gross, 2011; Sheppes et al., 2011) and reappraisal is ineffective in downregulating intense negative emotions (Raio et al., 2013; Shafir et al., 2015). Similarly, it has been found that people are unlikely to reappraise their emotional experiences at the start of an emotional episode (Kalokerinos et al., 2017), and may respond negatively to sharing partners stimulating cognitive reappraisal at the start of a sharing episode (Rimé, 2009). It should be noted, however, that this is not always dysfunctional as preliminary termination of an emotional episode may interfere with the functional nature of emotions stimulating responsiveness to important changes in one’s environment (Keltner & Gross, 1999).

Positive reappraisal may not always come naturally, as when a person experiencing a negative emotion does not manage to see any positive aspect to a negative experience. One strategy that may help in this regard is self-distancing. When people think about an emotional experience, they may do so from a self-immersed perspective in which self-relevant events and emotions are (re-)experienced in a first-person perspective through their own eyes (Nigro & Neisser, 1983). Alternatively, one may adopt a self-distanced perspective in which individuals focus on their experiences from the perspective of an observer or “fly on the wall” (Libby & Eibach, 2002; McIsaac & Eich, 2004).

Verduyn and colleagues examined whether these two perspectives have differential effects on the duration of emotional experience (Verduyn et al., 2012b). Participants were asked to recollect positive and negative emotions experienced earlier during the day, and repeatedly indicated which perspectives they adopted when thinking about the emotion-eliciting event during the emotional episode. People most often adopted a self-immersed perspective but when they managed to think about the emotional event using a self-distanced perspective, the emotional episode was more likely to end. Follow-up research revealed that self-distancing prevents negative emotions to accumulate (RÉSibois et al., 2018b), and this is especially so in people suffering from high levels of depressive symptoms (RÉSibois et al., 2018a).

One mechanism through which self-distancing may accelerate emotional recovery is by stimulating positive reappraisal (Kross & Ayduk, 2008).

In sum, while the initial appraisal of an emotional event determines the initial intensity of an emotional response, the appraisal process continues throughout the emotional episode. When the appraisal configuration remains largely stable, the emotion is unlikely to end, unless alternative events capture one's attention leading to a (temporary) termination of the emotional episode. Reappraisal may not always be easy, especially when emotion intensity is high. However, trying to adopt a self-distanced perspective or sharing one's emotional experience with a partner who stimulates reappraisal at the right moment in time, may result in a more positive take on a negative event. These reappraisal processes may shut down the negative emotional episode. Interestingly, the same holds for positive emotions as reappraising a positive event in a negative manner shortens the duration of positive emotional experiences as well.

1.5 Directions for Future Research

Empirical research on emotion duration has demonstrated that emotional episodes can last for seconds, minutes, hours or even longer. Moreover, first insights on the determinants and processes underlying emotion duration have been obtained. However, more work is needed to increase our understanding of the duration of emotions.

First, most research on emotion duration conceptualized the end of an emotional episode as the first return to baseline. While this choice makes emotion duration especially amendable to empirical research, it does not allow concluding whether a particular determinant of emotion duration stimulates only temporary relief or results in stable emotional recovery. For example, distraction and reappraisal processes have both been found to shorten the duration of emotional episodes but while the former may only lead to a state of temporary relief, the latter may be more effective at fully closing an emotional episode (Kross & Ayduk, 2008). Future research is necessary to better disentangle temporary relief from stable emotional recovery.

Second, most research on emotion duration is correlational. As such, it is often not clear whether processes such as attention, perspective taking or reappraisal shut down an emotional episode, or whether the approaching end of an emotional episode (stimulated by other processes) allows one to refocus attention, adopt a self-distanced perspective or reappraise an emotional event. Emotion generation and regulation mutually influence each other over time (Gross, 2015) and more research is necessary to chart and disentangle these effects.

Third, in research on emotion duration, regulation strategies are typically examined in isolation. However, it is increasingly becoming clear that people often use a variety of strategies to regulate their emotions (Brans et al., 2013; Brans & Verduyn, 2014). Some strategies may only impact emotion duration when the strategy is used at the right time (Kalokerinos et al., 2017) or when preceded or followed by other regulation strategies (Peuters et al., 2019).

Fourth, in this chapter I described processes underlying emotion duration at a psychological level. However, ultimately, these processes are mediated at the neural level. First insights into the neural mechanisms underlying emotion duration have been obtained (Heller & Casey, 2016; Verduyn et al., 2015; Waugh et al., 2015). Interestingly, research on the neural basis of emotion dynamics increasingly combines neuroimaging tools with experience sampling methods to overcome the limitations associated with measuring emotion duration in the lab (Heller et al., 2015; Provenzano et al., 2018). Studies like these are highly valuable and will deepen our understanding of the duration of emotions.

Finally, more research is necessary on the duration of the behavioral and physiological component of emotional responses, as well as how these components interact with emotional experience. Due to practical limitations, it was for a long time not possible to properly measure dynamics in all emotion components simultaneously as they unfold in daily life but breakthroughs in affective sensing and computing may spur new exciting insights on emotion duration in the near future.

1.6 Concluding Statement

Kuppens and Verduyn (Kuppens & Verduyn, 2017) formulated four fundamental principles underlying emotion dynamics: the principles of contingency, inertia, regulation, and interaction. These principles also relate to the processes underlying the specific dynamic feature discussed in the present chapter: emotion duration.

According to the principle of contingency, emotions consist of responses to things extrinsic to them. In this chapter, I illustrated how emotional episodes arise in response to external and internal events, and how these events, as well as possible other (distracting) events, continue to impact the emotion as it unfolds over time, ultimately influencing the duration of the emotional episode.

According to the principle of inertia, emotions display an intrinsic resistance to change causing them to carry over from one moment to the next. In this chapter, I illustrated that emotional episodes tend to be characterized by valence-congruent thoughts that prolong emotional episodes, consistent with research on emotion-congruent processing (Lerner & Keltner, 2001) showing that the way we feel influences the way we perceive the world, which in turn, feeds back into the way we feel.

According to the principle of regulation, emotions are continuously regulated to maximize fit with a desired state, which may change as the emotion unfolds. In this chapter, I illustrated how emotion regulation strategies as distraction, positive reappraisal, self-distancing and social sharing can be harnessed to shorten the duration of negative emotional episodes by providing counterweight to the forces of emotional inertia.

Finally, according to the principle of interaction, emotions and emotion components continuously interact over time. In this chapter, I discussed research on the interaction between cognitions and the duration of emotional experience but more research applying the principle of interaction to research on emotion duration is necessary.

References

- Aldao, A. (2013). The future of emotion regulation research: Capturing context. *Perspectives on Psychological Science*, 8(2), 155–172. <https://doi.org/10.1177/1745691612459518>
- Beedie, C. J., Terry, P. C., & Lane, A. M. (2005). Distinctions between emotion and mood. *Cognition and Emotion*, 19(6), 847–878. <https://doi.org/10.1080/02699930541000057>
- Beike, D. R., & Wirth-Beaumont, E. T. (2005). Psychological closure as a memory phenomenon. *Memory*, 13(6), 574–593. <https://doi.org/10.1080/09658210444000241>
- Block, J., & Kremen, A. M. (1996). IQ and ego-resiliency: Conceptual and empirical connections and separateness. *Journal of Personality and Social Psychology*, 70(2), 349–361. <https://doi.org/10.1037/0022-3514.70.2.349>
- Brans, K., Koval, P., Verduyn, P., Lim, Y. L., & Kuppens, P. (2013). The regulation of negative and positive affect in daily life. *Emotion*, 13(5), 926–939. <https://doi.org/10.1037/a0032400>
- Brans, K., Van Mechelen, I., Rimé, B., & Verduyn, P. (2014). To share, or not to share? Examining the emotional consequences of social sharing in the case of anger and sadness. *Emotion*, 14(6), 1062–1071. <https://doi.org/10.1037/a0037604>
- Brans, K., & Verduyn, P. (2014). Intensity and duration of negative emotions: Comparing the role of appraisals and regulation strategies. *PLoS One*, 9(3). <https://doi.org/10.1371/journal.pone.0092410>
- Bylsma, L. M., Croon, M. A., Vingerhoets, A. J. J. M., & Rottenberg, J. (2011). When and for whom does crying improve mood? A daily diary study of 1004 crying episodes. *Journal of Research in Personality*, 45(4), 385–392. <https://doi.org/10.1016/j.jrp.2011.04.007>
- Charles, S. T., Mogle, J., Urban, E. J., & Almeida, D. M. (2016). Daily events are important for age differences in mean and duration for negative affect but not positive affect. *Psychology and Aging*, 31(7), 661–671. <https://doi.org/10.1037/pag0000118>
- Darwin, C. (1965). *The expression of the emotions in man and animals*. University of Chicago Press.
- Davidson, R. J. (1998). Affective style and affective disorders: Perspectives from affective neuroscience. *Cognition and Emotion*, 12(3), 307–330.
- Ekman, P. (1984). Expression and the nature of emotion. In K. Scherer & P. Ekman (Eds.), *Approaches to emotion* (pp. 319–344). Lawrence Erlbaum Associates.
- Ekman, P., & Friesen, W. V. (1982). Felt, false, and miserable smiles. *Journal of Nonverbal Behavior*, 6(4), 238–252.
- Fennell, M. J., Teasdale, J. D., Jones, S., & Damlé, A. (1987). Distraction in neurotic and endogenous depression: An investigation of negative thinking in major depressive disorder. *Psychological Medicine*, 17(4), 441–452.
- Fredrickson, B. L., & Levenson, R. W. (1998). Positive emotions speed recovery from the cardiovascular sequelae of negative emotions. *Cognition and Emotion*, 12(2), 191–220. <https://doi.org/10.1080/026999398379718>
- Freund, A. M., & Keil, A. (2013). Out of mind, out of heart: Attention affects duration of emotional experience. *Cognition and Emotion*, 27(3), 549–557. <https://doi.org/10.1080/02699931.2012.725574>
- Frijda, N. H. (2007). *The laws of emotion*. Lawrence Erlbaum Associates Publishers.
- Frijda, N. H., Mesquita, B., Sonnemans, J., & Van Goozen, S. (1991). The duration of affective phenomena or emotions, sentiments and passions. In K. T. Strongman (Ed.), *International review of studies on emotion* (pp. 187–225). Wiley.
- Gilboa, E., & Revelle, W. (1994). Personality and the structure of affective responses. In S. Van Goozen, N. E. Van De Poll, & J. A. Sargent (Eds.), *Essays on current issues in the field of emotion theory* (pp. 134–159). Erlbaum.
- Gross, J. J. (1998a). Antecedent- and response-focused emotion regulation: Divergent consequences for experience, expression, and physiology. *Journal of Personality and Social Psychology*, 74(1), 224–237. <https://doi.org/10.1037/0022-3514.74.1.224>
- Gross, J. J. (1998b). The emerging field of emotion regulation: An integrative review. *Review of General Psychology*, 2(3), 271–299. <https://doi.org/10.1037/1089-2680.2.3.271>

- Gross, J. J. (2015). Emotion regulation: Current status and future prospects. *Psychological Inquiry*, 26(1), 1–26. <https://doi.org/10.1080/1047840X.2014.940781>
- Heller, A. S., & Casey, B. J. (2016). The neurodynamics of emotion: Delineating typical and atypical emotional processes during adolescence. *Developmental Science*, 19(1), 3–18. <https://doi.org/10.1111/desc.12373>
- Heller, A. S., Fox, A. S., Wing, E. K., McQuisition, K. M., Vack, N. J., & Davidson, R. J. (2015). The neurodynamics of affect in the laboratory predicts persistence of real-world emotional responses. *Journal of Neuroscience*, 35(29), 10503–10509. <https://doi.org/10.1523/JNEUROSCI.0569-15.2015>
- Heller, A. S., Johnstone, T., Shackman, A. J., Light, S. N., Peterson, M. J., Kolden, G. G., et al. (2009). Reduced capacity to sustain positive emotion in major depression reflects diminished maintenance of fronto-striatal brain activation. *Proceedings of the National Academy of Sciences*, 106(52), 22445–22450. <https://doi.org/10.1073/pnas.0910651106>
- Heylen, J., Van Mechelen, I., Verduyn, P., & Ceulemans, E. (2016). KSC-N: Clustering of hierarchical time profile data. *Psychometrika*, 81(2), 411–433. <https://doi.org/10.1007/s11336-014-9433-x>
- Heylen, J., Verduyn, P., Van Mechelen, I., & Ceulemans, E. (2015). Variability in anger intensity profiles: Structure and predictive basis. *Cognition and Emotion*, 29(1), 168–177. <https://doi.org/10.1080/02699931.2014.896783>
- Hovasapian, A., & Levine, L. J. (2018). Keeping the magic alive: Social sharing of positive life experiences sustains happiness. *Cognition and Emotion*, 32(8), 1559–1570. <https://doi.org/10.1080/02699931.2017.1422697>
- Hutcherson, C. A., Goldin, P. R., Ochsner, K. N., Gabrieli, J. D., Feldman Barrett, L., & Gross, J. J. (2005). Attention and emotion: Does rating emotion alter neural responses to amusing and sad films? *NeuroImage*, 27(3), 656–668. <https://doi.org/10.1016/j.neuroimage.2005.04.028>
- Joormann, J., & Siemer, M. (2004). Memory accessibility, mood regulation, and dysphoria: Difficulties in repairing sad mood with happy memories? *Journal of Abnormal Psychology*, 113(2), 179–188. <https://doi.org/10.1037/0021-843X.113.2.179>
- Kalokerinos, E. K., Résibois, M., Verduyn, P., & Kuppens, P. (2017). The temporal deployment of emotion regulation strategies during negative emotional episodes. *Emotion*, 17(3), 450–458. <https://doi.org/10.1037/emo0000248>
- Kaneko, M., Ozaki, Y., & Horike, K. (2018). Curiosity about a positive or negative event prolongs the duration of emotional experience. *Cognition and Emotion*, 32(3), 600–607. <https://doi.org/10.1080/02699931.2017.1324766>
- Keltner, D., & Gross, J. J. (1999). Functional accounts of emotions. *Cognition and Emotion*, 13(5), 467–480. <https://doi.org/10.1080/026999399379140>
- Kross, E., & Ayduk, O. (2008). Facilitating adaptive emotional analysis: Distinguishing distanced-analysis of depressive experiences from immersed-analysis and distraction. *Personality and Social Psychology Bulletin*, 34(7), 924–938. <https://doi.org/10.1177/0146167208315938>
- Kuppens, P., & Verduyn, P. (2015). Looking at emotion regulation through the window of emotion dynamics. *Psychological Inquiry*, 26, 72–79.
- Kuppens, P., & Verduyn, P. (2017). Emotion dynamics. *Current Opinion in Psychology*, 17, 22–26. <https://doi.org/10.1016/j.copsyc.2017.06.004>
- Lapate, R. C., & Heller, A. S. (2020). Context matters for affective chronometry. *Nature Human Behaviour*. <https://doi.org/10.1038/s41562-020-0860-7>
- Lerner, J. S., & Keltner, D. (2001). Fear, anger, and risk. *Journal of Personality and Social Psychology*, 81(1), 146–159. <https://doi.org/10.1037/0022-3514.81.1.146>
- Libby, L. K., & Eibach, R. P. (2002). Looking back in time: Self-concept change affects visual perspective in autobiographical memory. *Journal of Personality and Social Psychology*, 82(2), 167–179. <https://doi.org/10.1037/0022-3514.82.2.167>
- McIsaac, H. K., & Eich, E. (2004). Vantage point in traumatic memory. *Psychological Science*, 15(4), 248–253. <https://doi.org/10.1111/j.0956-7976.2004.00660.x>

- Mehta, A., Formanowicz, M., Uusberg, A., Uusberg, H., Gross, J. J., & Suri, G. (2020). The regulation of recurrent negative emotion in the aftermath of a lost election. *Cognition and Emotion*, 34(4), 848–857. <https://doi.org/10.1080/02699931.2019.1682970>
- Nigro, G., & Neisser, U. (1983). Point of view in personal memories. *Cognitive Psychology*, 15(4), 467–482. [https://doi.org/10.1016/0010-0285\(83\)90016-6](https://doi.org/10.1016/0010-0285(83)90016-6)
- Nolan, S. A., Roberts, J. E., & Gotlib, I. H. (1998). Neuroticism and ruminative response style as predictors of change in depressive symptomatology. *Cognitive Therapy and Research*, 22(5), 445–455. <https://doi.org/10.1023/A:1018769531641>
- Nolen-Hoeksema, S., & Morrow, J. (1993). Effects of rumination and distraction on naturally occurring depressed mood. *Cognition and Emotion*, 7(6), 561–570. <https://doi.org/10.1080/02699939308409206>
- Pe, M., Frederickx, S., Verduyn, P., De Laet, I., Brans, K., Hofmans, J., et al. (2013). The relationship between arousal and the remembered duration of positive events. *Applied Cognitive Psychology*, 27(4), 493–496. <https://doi.org/10.1002/acp.2926>
- Peuters, C., Kalokerinos, E. K., Pe, M. L., & Kuppens, P. (2019). Sequential effects of reappraisal and rumination on anger during recall of an anger-provoking event. *PLoS One*, 14(1), 1–16. <https://doi.org/10.1371/journal.pone.0209029>
- Pieper, S., & Brosschot, J. F. (2005). Prolonged stress-related cardiovascular activation: Is there any? *Annals of Behavioral Medicine*, 30(2), 91–103. https://doi.org/10.1207/s15324796abm3002_1
- Provenzano, J., Bastiaansen, J. A., Verduyn, P., Oldehinkel, A. J., Fossati, P., & Kuppens, P. (2018). Different aspects of the neural response to socio-emotional events are related to instability and inertia of emotional experience in daily life: An fMRI-ESM study. *Frontiers in Human Neuroscience*, 12, 1–10. <https://doi.org/10.3389/fnhum.2018.00501>
- Raio, C. M., Orederu, T. A., Palazzolo, L., Shurick, A. A., & Phelps, E. A. (2013). Cognitive emotion regulation fails the stress test. *Proceedings of the National Academy of Sciences*, 110(37), 15139–15144. <https://doi.org/10.1073/pnas.1305706110>
- Ray, R. D., Wilhelm, F. H., & Gross, J. J. (2008). All in the mind's eye? Anger rumination and reappraisal. *Journal of Personality and Social Psychology*, 94(1), 133–145. <https://doi.org/10.1037/0022-3514.94.1.133>
- Résibois, M., Kuppens, P., Van Mechelen, I., Fossati, P., & Verduyn, P. (2018a). Depression severity moderates the relation between self-distancing and features of emotion unfolding. *Personality and Individual Differences*, 123, 119–124. <https://doi.org/10.1016/j.paid.2017.11.018>
- Résibois, M., Rotgé, J. Y., Delaveau, P., Kuppens, P., Van Mechelen, I., Fossati, P., & Verduyn, P. (2018b). The impact of self-distancing on emotion explosiveness and accumulation: An fMRI study. *PLoS One*, 13(11), 1–19. <https://doi.org/10.1371/journal.pone.0206889>
- Résibois, M., Verduyn, P., Delaveau, P., Rotgé, J. Y., Kuppens, P., Van Mechelen, I., & Fossati, P. (2017). The neural basis of emotions varies over time: Different regions go with onset- and offset-bound processes underlying emotion intensity. *Social Cognitive and Affective Neuroscience*, 12(8), 1261–1271. <https://doi.org/10.1093/scan/nsx051>
- Rimé, B. (2009). Emotion elicits the social sharing of emotion: Theory and empirical review. *Emotion Review*, 1(1), 60–85. <https://doi.org/10.1177/1754073908097189>
- Rimé, B., Finkenauer, C., Luminet, O., Zech, E., & Philippot, P. (1998). Social sharing of emotion: New evidence and new questions. *European Review of Social Psychology*, 9, 145–189. <https://doi.org/10.1080/14792779843000072>
- Scherer, K. R., & Wallbott, H. G. (1994). Evidence for universality and cultural variation of differential emotion response patterning. *Journal of Personality and Social Psychology*, 66, 310–328.
- Schuyler, B. S., Kral, T. R. A., Jacquart, J., Burghy, C. A., Weng, H. Y., Perlman, D. M., et al. (2012). Temporal dynamics of emotional responding: Amygdala recovery predicts emotional traits. *Social Cognitive and Affective Neuroscience*, 9(2), 176–181. <https://doi.org/10.1093/scan/nss131>
- Shafir, R., Schwartz, N., Blechert, J., & Sheppes, G. (2015). Emotional intensity influences pre-implementation and implementation of distraction and reappraisal. *Social Cognitive and Affective Neuroscience*, 10(10), 1329–1337. <https://doi.org/10.1093/scan/nsv022>

- Sheppes, G., & Gross, J. J. (2011). Is timing everything? Temporal considerations in emotion regulation. *Personality and Social Psychology Review*, *15*(4), 319–331. <https://doi.org/10.1177/1088868310395778>
- Sheppes, G., Scheibe, S., Suri, G., & Gross, J. J. (2011). Emotion-regulation choice. *Psychological Science*, *22*(11), 1391–1396. <https://doi.org/10.1177/0956797611418350>
- Siegle, G. J., Granholm, E., Ingram, R. E., & Matt, G. E. (2001). Pupillary and reaction time measures of sustained processing of negative information in depression. *Biological Psychiatry*, *49*(7), 624–636. <https://doi.org/10.1016/S0006-3223%2800%2901024-6>
- Siegle, G. J., Steinhauser, S. R., Thase, M. E., Stenger, V. A., & Carter, C. S. (2002). Can't shake that feeling: Event-related fMRI assessment of sustained amygdala activity in response to emotional information in depressed individuals. *Biological Psychiatry*, *51*(9), 693–707.
- Sonnemans, J., & Frijda, N. H. (1994). The structure of subjective emotional intensity. *Cognition & Emotion*, *8*(4), 329–350.
- Tugade, M. M., & Fredrickson, B. L. (2004). Resilient individuals use positive emotions to bounce back from negative emotional experiences. *Journal of Personality and Social Psychology*, *86*(2), 320–333. <https://doi.org/10.1037/0022-3514.86.2.320>
- Van Mechelen, I., Verduyn, P., & Brans, K. (2013). The duration of emotional episodes. In D. Hermans, B. Rimé, & B. Mesquita (Eds.), *Changing emotions* (pp. 174–180). Psychology Press.
- Verduyn, P., & Brans, K. (2012). The relationship between extraversion, neuroticism and aspects of trait affect. *Personality and Individual Differences*, *52*(6), 664–669. <https://doi.org/10.1016/j.paid.2011.12.017>
- Verduyn, P., Delaveau, P., Rotgé, J. Y., Fossati, P., & Van Mechelen, I. (2015). Determinants of emotion duration and underlying psychological and neural mechanisms. *Emotion Review*, *7*, 330–335.
- Verduyn, P., Delvaux, E., Van Coillie, H., Tuerlinckx, F., & Van Mechelen, I. (2009a). Predicting the duration of emotional experience: Two experience sampling studies. *Emotion*, *9*(1), 83–91. <https://doi.org/10.1037/a0014610>
- Verduyn, P., & Lavrijsen, S. (2015). Which emotions last longest and why: The role of event importance and rumination. *Motivation and Emotion*, *39*(1), 119–127. <https://doi.org/10.1007/s11031-014-9445-y>
- Verduyn, P., Van Mechelen, I., & Frederix, E. (2012a). Determinants of the shape of emotion intensity profiles. *Cognition and Emotion*, *26*(8), 1486–1495. <https://doi.org/10.1080/0269993.1.2012.662152>
- Verduyn, P., Van Mechelen, I., Kross, E., Chezzi, C., & Van Bever, F. (2012b). The relationship between self-distancing and the duration of negative and positive emotional experiences in daily life. *Emotion*, *12*(6), 1248–1263. <https://doi.org/10.1037/a0028289>
- Verduyn, P., Van Mechelen, I., & Tuerlinckx, F. (2011). The relation between event processing and the duration of emotional experience. *Emotion*, *11*(1), 20–28. <https://doi.org/10.1037/a0021239>
- Verduyn, P., Van Mechelen, I., Tuerlinckx, F., Meers, K., & Van Coillie, H. (2009b). Intensity profiles of emotional experience over time. *Cognition & Emotion*, *23*(7), 1427–1443. <https://doi.org/10.1080/02699930902949031>
- Verduyn, P., Van Mechelen, I., Tuerlinckx, F., & Scherer, K. (2013). The relation between appraised mismatch and the duration of negative emotions: Evidence for universality. *European Journal of Personality*, *27*(5), 481–494. <https://doi.org/10.1002/per.1897>
- Villano, W. J., Otto, A. R., Ezie, E. C., Gillis, R., & Heller, A. S. (2020). Temporal dynamics of real-world emotion are more strongly linked to prediction error than outcome. *Journal of Experimental Psychology: General*, *149*(9), 1755–1766. <https://doi.org/10.1037/xge0000740>
- Waugh, C. E., Hamilton, J. P., & Gotlib, I. H. (2010). The neural temporal dynamics of the intensity of emotional experience. *NeuroImage*, *49*(2), 1699–1707. <https://doi.org/10.1016/j.neuroimage.2009.10.006>
- Waugh, C. E., Shing, E. Z., & Avery, B. M. (2015). Temporal dynamics of emotional processing in the brain. *Emotion Review*, *7*(4), 323–329. <https://doi.org/10.1177/1754073915590615>