

Changes and stabilities in emotional memories

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Introduction

Close your eyes and observe the memories that come into your mind. It is very likely that the first ones you retrieve are the ones in which you were personally involved. We can also predict that they are related to events that elicited pleasure. However, if you keep on thinking about your past, it is probable that, throughout the retrieval process, some more unpleasant memories will also surface among the majority of agreeable ones.

This simple example shows that, when prompted to remember the past, we tend to select primarily autobiographical memories, which are central in defining our identity, rather than events that happened to others. Furthermore, memories with an emotional flavor are easier to retrieve in comparison to episodes that do not involve emotion. Based on this simple observation, one might conclude that within the field of emotion research, the study of *emotional memories*, which are memories for events that elicited an affective response at the time of their occurrence, would hold a central place. Likewise, one might assume that memory research is particularly keen on examining how affect can influence the encoding, retrieval, and maintenance of memories. Surprisingly, the reality is more complex, as both research fields have developed independently. This absence of close connections between the two fields has had significant repercussions for the study of emotional memories.

The most fundamental repercussion is the neglect of a fine-tuned approaches to domains outside researchers' particular areas of expertise. Research on emotional memories is thus characterized by unbalanced approaches. An emotion researcher will envision several aspects involved in affect responses (e.g., physiological markers, facial expression, appraisals,

discrete emotions), but will consider only basic aspects of memory (e.g., free recall).

Conversely, a memory researcher will likely limit the evaluation of emotion to self-reports of arousal and valence, but will consider several dimensions of memory (e.g., accuracy, consistency, phenomenology, confidence, content, etc.). A central goal of this chapter is to go beyond this limitation by combining our areas of expertise, which is primarily emotion for one of us (OL) and autobiographical memory for the other (AC), but both with sufficient knowledge and openness to include the constructs and methods of the other field.

Examining emotional memories suggests two fundamentally distinct approaches: the effect of emotion on memory and the effect of memory on emotion. So far, studies have mostly examined how emotional dimensions impact memory performance. This is therefore the focus of the present chapter. The influence of memories on affective processing is briefly discussed at the end of the chapter.

The first section of this chapter aims to inform emotion researchers of some central dimensions and constructs in memory research and do the same for memory researchers with regard to the domain of emotion. Whatever one's expertise, all readers can then go through the rest of the chapter with a more balanced view of the two domains. The second section highlights current findings on the effects of emotions on autobiographical memories, showing an overall Emotion-enhanced memory effect (EEM). This section addresses explanatory processes for the EEM and factors that can modulate it, such as tunnel memory, availability of working memory resources, and valence of the stimulus. We also briefly consider the current limitations of the existing research.

In the third section, we move to the core issue of the chapter: whether and how emotional memories change. Four key effects regarding changes in emotional memories are reviewed: the Positivity Bias, the Fading Affect Bias, the Optimism Bias, and the Negativity Bias. We also examine contexts and traits that favor the stability of emotional memories. The alexithymia construct is a perfect example to demonstrate the stability of emotional memories.

Finally, we introduce the specific case of flashbulb memories, which illustrates various aspects about how emotional responses can affect retrieval in the context of encoding. Flashbulb memories are memories of the reception context when one learns about an important, surprising, and consequential event (Brown & Kulik, 1977; Luminet & Curci, 2018). This is probably the only domain of research in which there has been an attempt to link broader perspectives from emotion and memory research together. The chapter ends with

research perspectives and five recommendations for researchers on how to address current unsolved questions.

a) Key constructs

Defining emotion

Emotions are “episodic, relatively short-term, biologically-based patterns of perception, experience, physiology, action, and communication that occur in response to specific physical and social challenges and opportunities” (Keltner & Gross, 1999, p. 468). A complete emotion response includes three components: physiological, behavior-expressive, and cognitive-experiential (e.g., Bradley & Lang, 2000; Mauss et al., 2005). At the cognitive-experiential level, the literature distinguishes between two initial responses: appraisals and action readiness (Frijda, 1986).

Appraisals are a person's subjective evaluation of the personal significance of a situation, object, or event (Scherer, 1999). Experienced feelings are continually modified because appraisals may change in relevance and intensity over time depending on personal meaning, such as values, beliefs, goals, and experiences (Ellsworth & Scherer, 2003). Each time people detect, identify or recognize information that is relevant to reach goals they judge important, a set of appraisals are triggered. For instance, appraising a situation as risky and threatening triggers the experience of fear, while appraisals of harm and vulnerability trigger compassion. The central dimensions of appraisal include valence, novelty, expectedness, importance, familiarity, agency, coping potential, goal conduciveness, fairness, compatibility with social standards, and norms (e.g., Ellsworth & Scherer, 2003; Scherer, 2019; Scherer & Moors, 2019).

In parallel, a state of action readiness allows for the interruption of current actions and processes in order to initiate urgent responses. However, due to socialization and normative constraints, emotions rarely lead to observable behaviors. Action readiness therefore involves inhibition capacities to prevent external behaviors from occurring (Frijda et al., 1989). For example, when experiencing intense anger, an urge of physical or psychological aggression is automatically activated.

It is through these initial responses that people experience a subjective and distinct mental state. Appraisal theories provide a dynamic view of emotional responses in which

feelings are continually modified (Ellsworth & Scherer, 2003). In addition to appraisals and action tendencies, the cognitive-experiential component of emotions includes specific emotional feeling states (e.g., joy, anger, relief, regret), bodily responses (e.g., lump in the throat, feeling cold or hot, dizziness), and different components of emotion intensity (e.g., total emotional impact, peak, duration) (Frijda, et al., 1992; Sonnemans & Frijda, 1994). The behavior-expressive component involves facial expressions, vocal expressions, postures, and gestures. The physiological component is related to objective measures such as heart rate variability or skin conductance.

Emotions are distinguished from mood on many different dimensions. Emotions involve a quicker triggering speed; a lower frequency of occurrence; a higher subjective intensity; the possibility of identifying triggers more easily; a shorter duration; and different properties (Hot, Grynberg, Desmedt, & Luminet, 2021). Regarding properties, while emotion modulates action through action tendencies and behavioral responses, mood has no direct effect on behaviors. It can only modulate cognitive content (e.g., mood facilitates accessibility in memory when there is congruency between mood and the type of material being remembered) or cognitive processes (e.g., positive mood facilitates flexibility).

So far, most studies examining the effects of emotion on memory have been limited to the cognitive-experiential component. But even within that component, no study examined concurrently the dimensions described above. We will elaborate on this limit at the end of the section and in our recommendations at the end of the chapter.

Defining episodic memory and autobiographical memory (ABM)

Memory is an umbrella concept that combines the ways by which we learn, know, or recall information. It includes how we remember personal past events, but also how we know that Kiev is the capital of Ukraine, how we keep in mind numbers when doing mental calculation, how our body knows how to move when riding a bike or how we represent events that matter to the community. For the scope of this chapter, we are going to focus on *episodic memories* and *autobiographical memories*. Episodic memories are memories about personally experienced events situated in place and time that lasted no longer than a few hours (Tulving, 1984). In order to remember these episodic memories, one needs to be able to mentally travel back in time to re-experience the event. Episodic remembering thus relies on three important components: a sense of subjective time, autonoetic awareness, and a sense of self (Tulving, 2002). Most studies on episodic memory use lists of words or images of scenes as content to be encoded and remembered. Conversely, autobiographical memory is a broader set of

concepts that includes any memory and knowledge related to the self (Conway, 2005). It thus examines unique events (the time I went mountain climbing), repeated or extended events (annual family holidays at the beach) and semantic knowledge about who we are (I am a curious person). When it comes to emotional memories, we enter the realm of autobiographical memories for particular episodes or events (Holland & Kensinger, 2010). As we have seen above, emotions are “episodic” and “short-term”, but they are also very personal as their appraisals depend on their relevance for personal goals.

Episodic autobiographical memories are not perfect reproductions of past events. Rather, they are reconstructed every time they are brought back to mind, depending on the context of retrieval and the function of the memory (Bartlett, 1932). This constructive process – essential for the efficient functioning of memory in an adaptive way – can lead to changes in the content of the memory but also in its appraisal or emotional response (Schacter, 2012). Therefore, when studying autobiographical memories, researchers can focus on different characteristics of their operationalization. Just as emotional responses are more than their cognitive-experiential component, memories can be examined for their *content* (e.g., what is remembered, what is forgotten, how accurate the memory is, how consistent it is over multiple retellings, etc.), but also for their *recall processes* (e.g., is the retrieval voluntary or involuntary), the *phenomenological experience* (e.g. how vivid is the memory, how confident is the person, what emotions are experienced when remembering), or the *function* served by the memory (e.g. identity-related, social, directive,...).

Depending on the research questions, researchers can elicit memories from participants in different ways. The techniques can range from diary studies, where participants take notes on their thoughts, to laboratory studies, where participants receive instructions to guide their retrieval. Instructions can come in the form of word cues that may be neutral words (e.g., table), emotional words (e.g., anger) or emotion-provoking terms (e.g., doctor) (e.g., Koppel & Berntsen, 2015). Other instruction types might cue participants with epochs or time periods and ask for specific (sometimes important) memories from that time (e.g., Levine et al., 2002). Researchers can also ask questions directly related to what they want to study. For example, if they wish to elicit only emotional memories, they might request that participants retrieve highly positive or negative events (e.g., Bohanek et al., 2005). They can also directly ask for specific events of interest, such as traumatic events (e.g., Berntsen & Rubin, 2006), major public events, such as the 9/11 attacks (Luminet et al., 2004) or family anecdotes (Cordonnier et al., 2021). Depending on the technique used, participants are more or less likely to elicit emotional memories. What matters then will be the research question.

Are we trying to evaluate the preponderance of emotional memory retrieval? Do we want to investigate the phenomenological experience of positive versus negative memories? Are we measuring the likelihood of false memories for highly intense events?

b) Effects of emotions on episodic/autobiographical memory

Three main sources are involved in retrieval: the environment (including retrieval cues and specificities of the context), internal states (including our goals and motivations) and the match between state at encoding and state at retrieval (Kensinger & Ford, 2020). In this chapter, we will only focus on the first two aspects.

One of the most striking effects of emotion on memory is the *Emotion-Enhanced Memory* (EEM) effect. As its name suggests, it represents the fact that encoding, consolidation, and retrieval are enhanced when the information at encoding is emotional as opposed to neutral. EEM has been found in both humans and animals and for positive and negative information (Buchanan & Adolphs, 2002; Hamann, 2001; McGaugh, 2004; Ochsner, 2000). This holds across different types of material, including words (e.g., Davidson et al., 2006), narratives (e.g., Cahill & McGaugh, 1995), images (Ménétrier et al., 2013), and movies (Le Bigot et al., 2018). The effect is particularly strong for moderate levels of arousal and when there is a delay between the event and the recall (Ack Baraly et al., 2017). When the intensity of emotion is particularly high, however, memory enhancement does not occur anymore. In some cases, amnesic gaps can be observed (e.g., Brewin, 2014). There are also some negative effects related to EEM, the main ones being higher suggestibility and increased likelihood to endorse false memories (Corson & Verrier, 2007; Porter et al., 2003).

Different explanations have been provided for the robust effect of EEM. We present here three central ones. First, the biological perspective demonstrates that connections between emotion circuits and memory circuits are strong (Cahill & McGaugh, 1998). During an emotional episode, there is a liberation of stress hormones that increases the activity of the amygdala at encoding. The amygdala itself is strongly connected to several regions involved with memory, such as the hippocampus and the prefrontal cortex (e.g., McGaugh, 2004). Second, emotions affect different aspects of cognition that are important for successful encoding and retrieval (Hamann, 2001; Talmi, 2013). Among the cognitive factors that can explain EEM, one is related to the fact that emotional stimuli capture attention due to their higher saliency in the environment. Emotional stimuli are also more semantically interrelated. This better organization among stimuli facilitates more elaborative encoding of items, more efficient processing, and higher accessibility at retrieval, which influences memory priority

(Ack Baraly et al., 2017; Mather & Sutherland, 2011). Finally, emotional stimuli stand out relative to neutral ones. In other words, they are more distinctive. Importantly, only relative distinctiveness contributes to an enhanced memory. A third explanation relates to the functionality of emotions. Remembering affective events can help us bond with other people, better anticipate future similar contexts and use efficient emotion regulation mechanisms (Rasmussen & Berntsen, 2009). As our brain cannot remember all past events, emotions prioritize the encoding and retrieval of a particular event over others (Ack Baraly et al., 2017).

Although the EEM effect is robust, it does not occur to the same extent in every circumstance. A first noteworthy case is called *tunnel memory*. While emotion intensity can favor the encoding of information and its vivid retrieval, it can also prevent the recall of other information, particularly when highly negative events are involved (Berntsen, 2002). In this case, people can only encode the central elements (e.g., the weapon) but not peripheral ones (e.g., the face of the aggressor) as their attentional field is restricted. Different processing steps can explain the *tunnel memory effect*. First, emotional material is more salient and thus attracts more attention. Consequently, attentional resources prioritize the emotional information that is at the center of the visual field and treat it in a deeper way. Second, emotional material leads to more frequent reactivation, more details during consolidation and more cues during retrieval, but at the expense of peripheral information. Some contexts can, however, diminish the tunnel memory effect, such as post-stimulus elaboration about peripheral content presented alongside the emotional elements (Mickley Steinmetz, & Kensinger, 2013), or providing cognitive reappraisal strategies to participants faced with arousal content (Steinberger et al., 2011).

The amplitude of EEM is also related to the *availability of working memory resources*. Although EEM increases with the emotional intensity of words, it decreases when memory resources are less available (e.g., Chapman et al., 2013; Gomes et al., 2013; Yeung & Fernandes, 2021). Finally, the most studied, but also probably the most complex modulating influence on the EEM effect, is the *valence*. The findings of certain studies suggest that positive events make for better memories (positivity effect), while the findings of other studies argue that negative events result in better memories (negativity effect). Studies that have found enhanced memory for *pleasant* events are explained by the higher availability of positive information, which comes more readily in mind because people hold mainly positive self-schemas (Levine & Bluck, 2004). Experiencing pleasant emotions is therefore more likely to be self-relevant and thus more easily integrated into a person's conception of themselves (Matlin & Stang, 1978). However, when individuals focus more on

other perceptions rather than on self-referential ones (Skowronski & Carlston, 1987) or when they are depressed, they are more likely to remember negative experiences (for a review, see Holland & Kensinger, 2010). Regarding the different components of memory, positive emotions, as compared to negative emotions, seem to particularly enhance confidence in a specific memory, but this is not the only element that is affected. The risk of distortions also increases, which results in lower accuracy. This reduced accuracy for positive memories can be explained in different ways. Positive emotions favor heuristic processing as compared to more analytic processing in the case of negative emotions (e.g., Schwarz & Clore, 1996). Furthermore, positive events occur more frequently, which increases the risk that more related events interfere with the one to remember (Holland & Kensinger, 2010). Positive events are also more expected, which can create interferences between what is expected and what actually occurred. Finally, people are predisposed to believe that more positive events occurred in their life because it is beneficial for well-being to see our past through rose-colored glasses (Walker et al., 2003).

Conversely, many studies demonstrate a negativity effect with better retrieval for negative memories as compared to positive ones (Kensinger, 2007). People tend to pay more attention to losses than gains, feel more impact from negative than positive feedback, and process negative information more thoroughly than positive information (Baumeister et al., 2001). These asymmetries extend to memory performance. For instance, negative events are more likely to be associated with vivid recollection than positive ones (e.g., Dewhurst & Parry, 2000; Ochsner, 2000) and they are more likely to be recalled with greater consistency (Kensinger & Schacter, 2016). Finally, the visual details of negative events are retained with greater precision (Bowen et al., 2018).

In summary, negative events draw more attention and are processed more intensely. The advantage of negative memories mainly relates to consistency, degree of details, and vividness, while positive memories are more spontaneously available and held with more confidence. It is worth mentioning that emotional memories can also be used in a conscious, strategic way as an emotion regulation function at the time of retrieval (Pasupathi, 2003; Pillemer, 2009). As people are inclined to re-appraise negative events in a more positive way, they recall a negative experience as less unpleasant than when it happened.

This brief overview of the current literature on the effects of emotion on memory also highlights important limits as none of the existing studies include a full account of the dimensions that are central in each domain. Regarding emotion, most studies only examined the role of intensity or of valence, thus leaving open the effect of specific emotional states on

memory. The hypothesis is that the effects of high arousal negative emotions, such as fear or anger, will differ from the ones of low arousal, such as sadness or regret. Moreover, almost none of the current literature considers the dimensions of appraisal, action tendencies, or bodily sensations that are central to cognitive theories of emotion. One exception is the literature on flashbulb memories (discussed below) in which appraisals are considered as antecedents of emotion.

Regarding memory, studies have generally examined only one or two operationalizations of memory. Studies have tended to focus on the accessibility of emotional memories following a cue, on the accuracy of different details in laboratory studies, on the content of recalled memories, or on the phenomenological experience when remembering particular autobiographical events. Few have compared these different but complementary memory aspects.

c) Whether and how emotional memories change

Memories are free-flowing and ever-evolving. Even when we feel we are remembering things exactly as they occurred, variations and changes inevitably occur because of the (re)constructive nature of memory (Schacter 2012; Temler et al., 2020). Some details are added, some are forgotten, and others might be re-appraised or given new meaning. Beyond these natural variations, outside sources and effects can introduce errors in our memories. With regard to how well emotional memories resist these influences, the current scientific literature offers no consensus. In their literature review, Bookbinder and Brainerd (2016) concluded that, in experiments on spontaneous and implanted false memories, there was an increased chance of distortion and errors for negatively-valenced content. Other research has shown an opposite effect, where emotional memories were less prone to social contagion than neutral ones (Kensinger et al., 2016). Moreover, research on flashbulb memories has revealed less memory distortions when participants were displeased with the outcome of a public event (such as the verdict of the O.J. Simpson trial or the results of an important baseball match) than when they were happy with the outcome (Kensinger & Schacter, 2006; Levine & Bluck; 2004). These seemingly conflicting results highlight the need to distinguish between the different types of memory examined (e.g., false memory, autobiographical memory, flashbulb memory), as well as important distinction that should be made, but is rarely done, between the emotional content of the memory and participants' mood at encoding. Recent research suggests that only the former can influence false memories (Zhang et al., 2021).

Beyond these changes in the details of an event (studied in-depth in the forensic literature), we also note changes associated with the emotional component of the memory. Indeed, there is not always an agreement between the emotion felt when initially experiencing an event and the emotion experienced when mentally reliving it through memory. The difference can occur in terms of emotional intensity, but also sometimes in terms of type of discrete emotion. Consider how someone feels when their partner, whom they love, breaks up with them. You would assume that the person might be sad or angry, maybe feeling betrayed. However, months later, the intensity of these negative emotions will probably have receded. And maybe, years later, when the person is happily living with someone who is a better fit than the ex-partner, this memory might trigger relief or even contentment. In this section, we review some of the biases found when emotions and memory interact over time.

“My life has mostly been good and will be even better in the future.” This is how we can summarize in a few words the fact that autobiographical thinking is generally biased in favor of pleasant information (Schacter & Addis, 2007a; Walker & Skowronski, 2009). Indeed, when asked to list personal events from their past, participants tend to recall more positive events than negative ones (Suedfeld & Eich, 1995). This *Positivity Bias* can be explained in two ways. First, as discussed above, positive memories appear to be more readily accessible. Even involuntary memories – memories that come to mind without a deliberate effort to retrieve them – recorded in a diary were more often about pleasant than unpleasant past experiences (Berntsen, 1996). This ease of accessibility serves important evolutionary functions to maintain a positive version of the self (Rasmussen & Berntsen, 2009). A second explanation relates to the fact that, as time passes, negative memories are experienced with less intensity than positive memories (Walker & Skowronski, 2009). This is called the *Fading Affect Bias (FAB)*. Initially, this effect was mainly investigated using retrospective studies where participants were asked to “remember” the emotion felt at the time of the event, which attracted considerable criticism. But since then, the FAB has been found in longitudinal diary studies (Ritchie et al., 2009; Walker et al., 1997). The effect occurs relatively quickly. Gibbons and colleagues (2011) found that the FAB began within the first 12 hours after the event and remained stable for 3 months. Walker and colleagues (1997) noted an increase of the bias over time by comparing retention intervals of three months, one year, and four and a half years. This bias was also found in different cultures around the world, which attests to its robustness (Ritchie et al., 2014). According to many researchers, negative emotional fading generally serves as a healthy coping mechanism (Gibbons et al., 2015).

In studies evaluating FAB, there were some intriguing cases where the evaluation of the emotion, especially when measured on a bipolar response scale, changed not only in intensity but also in valence. In other words, events that were originally perceived as negative became positive with time or vice versa. Gibbons and Rollins (2016) examined the emotional evolution of more than 2200 autobiographical memories over time. When events were initially positive, their emotional intensity mostly remained fixed (56%) or faded (32%). It was only in five percent of cases that these memories became negative. However, when events were initially negative, and in accordance with the FAB, the intensity faded in 54% of cases and remained fixed in only 27% of cases. Furthermore, for more than 13% of memories, the emotion changed from negative to positive. This transformation in the valence of past events can occur over time, but it can also be used intentionally as an emotion regulation strategy called “cognitive reappraisal”. In cases of intense negative emotion, individuals may attempt to reinterpret the meaning of an event or its outcome to change its emotional trajectory. Studies have shown that applying this strategy also enhances the overall memory of the event. However, failure to successfully apply the strategy sees the intensity of the negative emotion(s) associated with the enhanced memory increase (Yeh et al., 2020).

The term *Positivity Bias* is also often used to reflect the robust finding that, compared to young adults, older adults show an increased retrieval of positive memories (Reed & Carstensen, 2012). The socio-emotional selectivity theory suggests that this bias comes from the fact that emotionally meaningful goals are more likely to be pursued later in life as time is perceived as more limited (Barber et al., 2016; Carstensen et al., 1999). To achieve these goals, older adults use cognitive control mechanisms to selectively remember more positive than negative information. Consequently, this effect is reduced when they are not able to use the full strength of their cognitive control (in a divided attention task or following cognitive decline) (Mather & Knight, 2005). Furthermore, older adults also better regulate their emotions related to negative memories. Comblain et al. (2005) found that, compared to younger participants, older participants rated negative memories as containing more positive feelings while being less complex.

Finally, we can also find this general inclination towards positive emotions when people engage in future thinking. In the last 20 years, memory researchers have argued that our memory system is not only used to reconstruct the past but also to adaptively imagine, plan, and anticipate personal future events (Schacter & Addis, 2007b). Studies have shown that when we consider our future, we do it with rose-colored glasses. We have a tendency to overestimate the likelihood of positive future events and underestimate the likelihood of

negative future events, a bias referred to as the *Optimism Bias* (D'Argembeau et al., 2011; Schacter & Addis, 2007a; Sharot, 2011).

This overly positive view of our past and our future is not found in every case. For example, depression has been correlated with a reduced positivity bias (Marsh et al., 2019) and Fading Affect Bias (Hitchcock et al., 2020). Furthermore, studies have not found such a positivity effect where collective memory and collective future thinking are concerned. Collective memory represents individual memories shared by members of a community that bear on the collective identity of that community (Hirst & Manier, 2008). Across five studies, Shrikanth and Szpunar (2021) found that, whereas memories of the personal past revealed a positivity bias as expected, memories of the public past were characterized by a *Negativity Bias*. In another study where participants had to list potential collective future events, these were more often negative than positive (Shrikanth et al., 2018). Finally, Topcu and Hirst (2020) found a Negativity Bias for collective memories, whereas future responses did not show any bias at all. In other words, the collective past was believed to be more negative than the collective future, yet this future was not perceived in an overly optimistic way as participants listed both potential negative and positive events.

Emotions are salient in the environment and thus we attend and process them in priority. There are, however, individual differences in the appraisal of situations, in the emotional reactions to those situations, and in individuals' abilities to retrieve them. This suggests that there are some people for which emotional memories would be more stable across time. A relevant trait in this context is alexithymia. Alexithymia is a multi-dimensional personality construct that has three major facets: 1) difficulties identifying one's feelings and distinguishing them from bodily sensations; 2) difficulties describing one's feelings to others; and 3) an externally oriented cognitive style that is utilitarian and does not include affective responses when facing stressful situations (Taylor, et al., 1997; 2016). Current perspectives in personality research adopt an interactionist framework, which assumes that individual differences in emotional responses are explained by the concomitant effects of the person (including their antecedents or history), the situation (including its novelty or controllability), and time (including updating as a function of changes in both context and person) (Kuppens et al., 2009). One important goal of this approach is therefore to identify the conditions under which individuals with higher scores on a specific trait, like alexithymia, show modulations in their emotional responses and cognitive functions, such as memory. As highlighted above, when the material is emotional, people with higher alexithymia scores showed emotion memory deficits at immediate testing, but no effect was found for neutral material (Luminet et

al., 2021b). Sometimes, these deficits in emotional memory occurred only when a confident “remember” response was required over a simple familiarity one (“know” response) (Vermeulen et al., 2010).

The facet “externally-oriented thinking” seems particularly related to emotional memory deficits and is also involved in the inability to interrupt the processing of unwanted items. This has been shown by using the directed forgetting paradigm, where participants learn certain lists or items while forgetting others. Greater externally oriented thinking scores were associated with deficits in memory for negative items that were meant to be remembered combined with more intrusions of negative items that were meant to be forgotten (which indicates inhibition deficits; Dressaire et al., 2015). These results suggest that higher alexithymia can create more interference in memory when emotional material is involved, thereby interfering with internal cognitive control.

While the FAB (see above) predicts that negative memories fade more over time than positive memories, individuals with higher alexithymia scores present the opposite pattern. Muir et al. (2017) found that their positive memories fade more over time and their negative memories fade less. A direct implication is that stronger alexithymia is related to experiencing negative emotions as more negative, along with reduced intensity of positive emotions.

Finally, despite generally reduced emotional memory, a specific congruent context between happy background music and memory for happy words helped higher alexithymia scorers. A positive correlation was indeed found between alexithymia scores and memory performance in this congruent context (Vermeulen et al., 2010). These results show that setting congruency between the content and the context can be beneficial in helping people with alexithymia better process positive emotional memories and retrieve them more often, which can be beneficial for their emotion regulation.

In conclusion, the accessibility and the emotional content of memory evolves over time. Humans have a general inclination towards positivism and optimism. We tend to preferentially retrieve positive memories and this tendency increases with age. Moreover, negative memories gradually fade, so that they do not instigate intense emotional reactions to their recall as they used to. Time might not necessarily heal all wounds, but overall, it does prioritize happier memories, and this positive mindset also translates into optimistic views about the future. Yet, some affective disorders, such as depression or alexithymia can influence this retrieval pattern.

d) Flashbulb memories: A particularly important phenomenon in understanding the effects of emotion on memory

In our introduction, we argued that the emotion and the memory fields of research do not overlap as often as they should. However, there is one domain that has attempted to integrate emotions and memory: the field of flashbulb memories (FBMs). FBMs are defined as memories for the reception context of an important, surprising, and consequential event (e.g., where you were, what you were doing, who was with you when event x occurred) (Luminet & Curci, 2018). Although it could equally apply to personal and public events, most studies examine public events, simply because they can be investigated with a large sample of participants.

Different models have been proposed to account for the formation of FBMs. All of them include emotional factors at encoding, semantic knowledge, and rehearsal processes that help maintain the information in memory. But a critical distinction between these models is that the ones proposed by memory researchers provide only a limited view of the role of emotional factors (e.g., Brown & Kulik, 1977; Conway et al., 1994; Conway, 1995; Er, 2003). For instance, appraisals are not considered (Conway et al., 1994; Day and Ross, 2014), or only one type, such as importance, is (Tinti et al, 2014). In studies where appraisals, such as novelty, are considered, they are not differentiated from surprise (Er, 2003), or surprise and intensity of emotion are considered together (Conway et al., 1994).

The exception here is the emotion-integrative model (Finkenauer et al., 1998) and its later adaptations (e.g., Luminet & Curci, 2009). This approach fully integrates emotion theories by making a distinction between appraisals (novelty, importance) and experienced feeling states, as well as between the specific emotional state of surprise and the general dimension of emotional intensity. Importantly, Structural Equation Modeling (SEM) analyses demonstrate that two distinct paths explain the formation of FBMs (see Luminet, 2018 for a review) (see Figure 1). The first path is direct, starting with the appraisal of novelty that results in the experience of surprise, which then directly predicts the formation of FBMs. The second one is indirect and starts with the appraisal of importance/consequentiality. If the evaluation is high, it leads the person to experience intense emotions, which then favors the development of rehearsal through three main modalities (personal thoughts, discussions with others, and exposure to the media). Rehearsal thus has an indirect impact on FBMs, through event-memory.

This model of FBM formation demonstrates that different emotional components have an impact on memory. For instance, there is a link between novelty and intensity of emotions (see Figure 1), which indicates that novelty also has an impact on the indirect path of FBM formation. When the direct effect is activated, it is therefore followed by the indirect one. But the data also indicate that, even in the absence of the direct path, a FBM can be formed with only the indirect one being triggered.

One could argue that this model is biased towards the emotional domain for which a detailed approach is included without considering advances in the memory field. Yet, current research on FBM also considers the importance highlighted by memory literature to include several dimensions of memory. In a recent paper examining FBMs of the terrorist attacks that occurred in Brussels in 2016, Cordonnier & Luminet (2021) showed that confidence in FBMs had only low correlations with FBM consistency and vividness, while these two dimensions highly correlated with each other.

Through the findings presented above, we argue that combining a multidimensional approach of emotion together with a multidimensional approach of memory is necessary to provide a complete understanding of the effects of emotion on memory.

Despite these similarities, variations in FBM formation can also occur as a function of the cultural context or the type of event considered. Regarding cultural differences, Stone et al. (2015) compared two situations with similar content that occurred in Australia and Japan. For the Australian sample, most factors previously found as predictors of FBMs were significant. In the Japanese sample, however, only one specific emotional state (sadness) was related to one aspect of FBM (confidence). These results suggest that the effect of emotional factors on FBM formation can differ across cultural contexts. A recent literature review has highlighted that almost all studies on FBM are limited to events that have occurred in Western countries, and/or only including Western participants (Muzzilini et al., 2022).

The type of situation can also be significant. Koppel et al. (2013) distinguished between two public events that occurred almost at the same time: the election of Obama and the emergency landing of a plane. The former was considered culturally and personally significant given its historic nature while the latter was considered noteworthy but less culturally significant. The authors investigated the predictors for event-memory accuracy and FBM consistency. Results showed that there were variations for the predictors of the two memory variables depending on the event, with emotional factors only playing a role for Obama's election. These results suggest that, when an event has a high level of cultural relevance, more immediate affective reactions determine the formation of FBMs. On the other

hand, if an event is noteworthy but less culturally relevant, factors from the indirect path such as rehearsal, play a more central role.

Overall, studies of FBM highlight the role of emotions on memory. Thanks to an approach that considers different dimensions of emotion and memory, they provide a promising avenue for the future of these interconnected fields.

e) Research perspectives and recommendations for researchers on how to address open questions

When considering the intersection between emotion and memory, the field of research is vast. Within the limited scope of this chapter, we chose to focus on the most studied junction: how experiencing emotions during an event influences the properties of its recall, including the accessibility of the memory; the amount the type, and the accuracy of details remembered; the quality of its phenomenological experience; and the various changes over time. In this section, we elaborate on future research questions and perspectives related to emotional memories, as well as other areas of research where emotion and memory interact.

The first recommendation relates to the need for memory researchers to include more elaborate perspectives on emotions and for emotion researchers to do the same where memory is concerned. Ultimately, the aim is to establish the field of emotional memories with researchers equally skilled in both domains. We therefore recommend adopting a multidimensional approach when assessing memory and emotion responses.

Regarding emotion, this would involve considering appraisals, action tendencies, bodily responses, and emotional intensity. If we consider appraisals, some further refinement is necessary to better understand the effect of emotion on memory. For instance, it would be worth considering two aspects of novelty: unexpectedness and exceptionality (Frijda, Kuipers, & ter Schure, 1989; Leventhal & Scherer, 1987; Scherer, 1988). Indeed, an event might be considered novel not only in terms of its sudden and unexpected occurrence, but also in terms of its disruptiveness with respect to one's ordinary routine. For instance, new testing of FBM models should consider this twofold nature of novelty, thereby taking into account the effects of both evaluations, especially for foreseeable events. It would also be valuable to take the distinction between importance and consequentiality into account (Luminet, 2022) and consider individual and collective levels of appraisals (e.g., importance/consequences for the self versus importance/consequences for a country) (e.g., Finkenauer et al., 1998; Luminet et

al., 2009). Broadening the assessment of appraisals would allow for a better understanding of their specific links with emotion dimensions.

A full emotional response also involves action tendencies. Based on the model developed by Frijda et al. (1989), it would be relevant to include central aspects, such as moving against, moving away, approach, inhibition, or hyperactivation. Along with measurements of bodily sensations, these measures can act as a complementary assessment of emotion intensity. Action tendencies and bodily sensations are activated only when higher levels of emotion are triggered, thus making the assessment of those higher levels of emotion more accurate, as well as providing a more precise threshold above which the EEM could disappear. Broadening the assessment of emotion intensity by considering additional dimensions, such as the peak, the end, or the duration of emotions (Sonnemans & Frijda, 1994), would be particularly relevant for the prediction of memory effects. For instance, individuals' memories of past affective episodes are predicted by the peak intensity and by emotions at the end of the episode, but not by their duration.

Regarding memory dimensions, most FBM studies have only considered one or, at best, two dimensions (see Muzzulini et al., 2022 for an overview). But more recently there has been an effort to consider different dimensions within the same study and examine how they are differently affected (e.g., Cordonnier & Luminet, 2021). The literature on autobiographical memory also suggests discrepancies across dimensions. For instance, Phelps and Sharot (2008) found that arousal does not have the same impact on memory accuracy and vividness.

The second recommendation is to consider a shift towards the assessment of specific emotional states. A comparison between positive and negative events could help clarify potential differences in terms of memory characteristics, such as consistency, vividness, details, or confidence. However, the available data do not distinguish any clear pattern based on simple valence criteria (Stone & Jay, 2018). A promising avenue would be to compare the effects of specific emotional feeling states of both valences on autobiographical memory. In the domain of FBMs, in addition to surprise, many events involve fear, sadness, or anger. In the case of positive events, distinguishing those eliciting pride from the ones eliciting joy also appears relevant. Another promising direction would be to disentangle the impact of attachment-related (love, gratitude, desire, and sympathy) and self-transcendent emotions (awe, gratitude, joy, and ecstasy) on autobiographical memory features, considering the notion of emotion families developed by Keltner (2019).

The third recommendation is to clarify how emotion influences memory. As discussed in this chapter, there are many competing theories as to the processes responsible for the emotion-enhanced memory (EEM) effect. Some suggest that emotions increase attentional focus during encoding and consolidation phases (Dolcos & Denkova, 2008), others argue that emotion influences retrieval processes (Kensinger & Ford, 2020), while some recent studies suggest that the appraisal of unexpectedness associated with an emotional event retroactively improves memory for that event (Congleton & Berntsen, 2020a; 2020b).

The fourth recommendation is to consider the other direction of the relationship by examining the influence of memories on emotions and mood more systematically. Memory can serve many functions. It provides the building blocks for a sense of self; it helps us bond with others, teach and inform; it provides us with valuable information to plan and make decisions (Bluck and Alea, 2002). But it can also be used as a tool to induce, change or enhance our mood, particularly when feeling low or down (Josephson, 1996; Wolf & Demiray, 2019). By voluntarily or involuntarily recalling positive autobiographical memories, individuals can alter the way they feel, a technique generally called “mood-regulation” or “mood-repair” (Hashimoto, et al., 2022; Rusting & DeHart, 2000). Studies examining this technique tend to simply compare the recall of positive versus neutral or negative memories. Future research should further examine the characteristics of these memories. Do they have to be important or recent? Do they need to be recalled in a coherent way, as we know that narrative coherence is related to well-being (e.g., Vanden Poel & Hermans, 2019; Waters & Fivush, 2015)? Are some positive emotions elicited by the recall (e.g., joy, pride, gratitude, excitement) more successful than others?

The fifth recommendation relates to affective memory. Whereas emotional memory refers to the declarative memory of events that elicited an emotional reaction and, on occasion, its implicit reactivation (especially with regards to the emotion of fear, see LeDoux, 1996, Phelps, 2004), the concept of affective memory represents the idea that “emotions can be encoded and retrieved [...] so that emotional aspects linked to memories of the personal past need not necessarily be new emotional responses caused by an act of recollection of a past event” (Trakas, 2021, p. 121). In other words, research on affective memory examines whether we can have a separate, non-declarative memory of emotions. The study of the revival of past emotions matters, particularly when considering the case of post-traumatic stress disorder (PTSD). Individuals suffering from PTSD report a strong sense of reliving the original emotion as if the event was not a memory but occurring again in the present (Brewin & Holmes, 2003). However, even in such cases, it is unclear whether it is a new emotion

elicited by the (implicit) retrieval of an emotional memory or if the emotion itself is, indeed, an affective memory. Trakas (2021) proposes to distinguish emotional memory from affective memory by appealing to appraisal theories of emotions and the concept of relationality. According to her, the main distinction lies in the “environment-subject relation”, where the subject of emotional memory is the rememberer’s present self and the subject of affective memory is the rememberer’s past self. Thus, in some cases, there could be a memory without a complete emotional experience but just a recollection of a past event with an “emotional coloration” associated with it. Nevertheless, this distinction is only theoretical and future research should attempt to examine the concept of affective memory. In conclusion, it is clear that emotion and memory researchers still have a lot to learn from one another to make significant advances in the field of emotional memories.

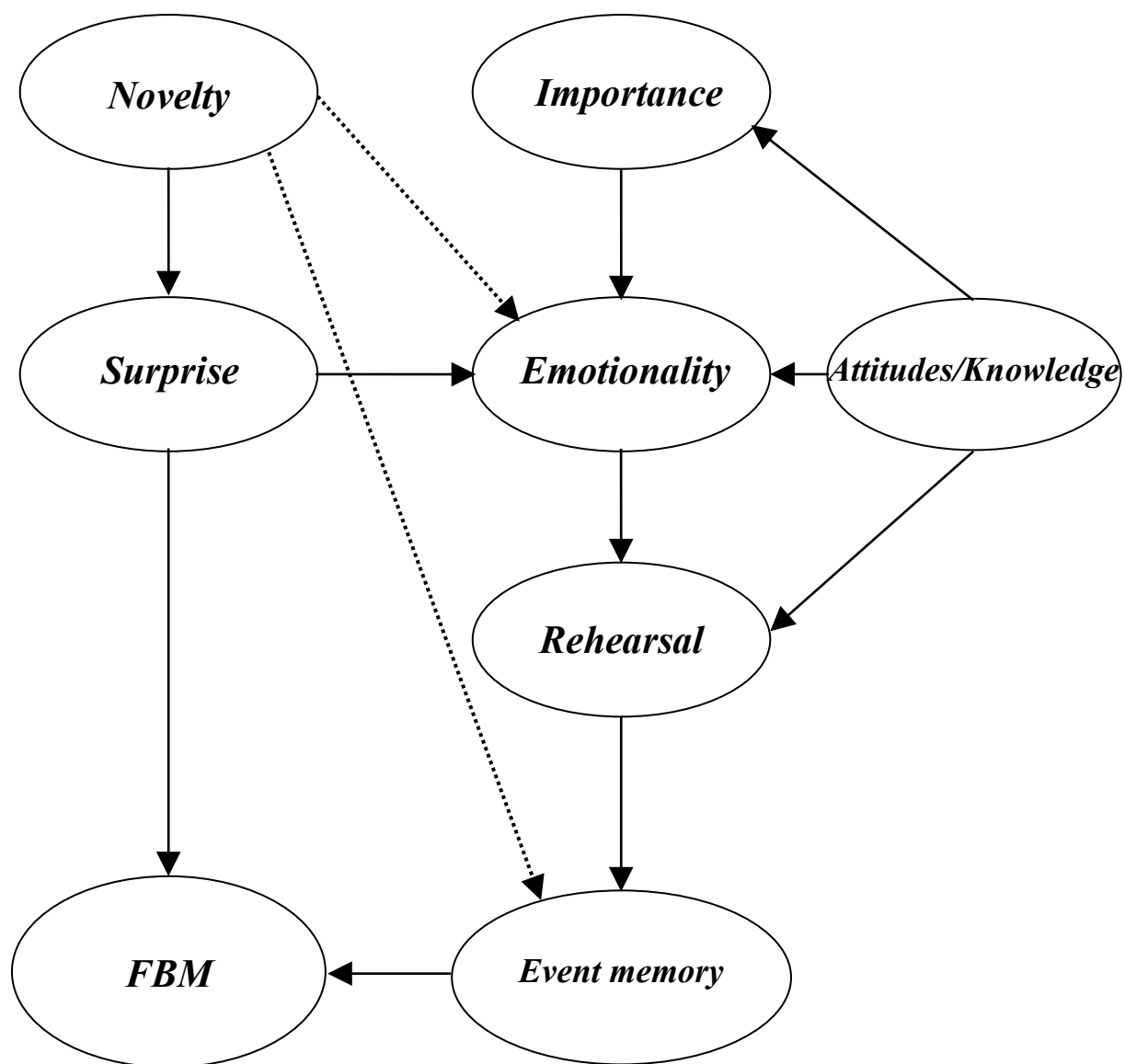
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Figure 1. Model for the formation of Flashbulb memories (from Luminet & Curci, 2009)



Note. FBM = Flashbulb memory

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