





# Memory and Emotion

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## INTRODUCTION

The topic of this chapter, memory and emotion, is ideally suited to substantiate Kurt Lewin's notion that there is nothing more practical than a good theory – affording a reasonable motto for a handbook of applied memory. Numerous findings on affect and cognition have face validity or content validity for practically important questions in such diverse fields as social influence, stereotyping, education, law, achievement, and health. Empirical discoveries and practical insights from all these areas reflect the fertility and explanatory power of distinct theories that enabled this research. Conversely, the evidence gathered in applied domains has greatly increased the development of more refined theories and research paradigms.

The goal of the present chapter is to provide an overview of theoretical and applied work on memory and emotion, in a way that highlights the practical value of a theory-driven approach. To meet this goal, we first outline a sensible theoretical framework before we present an overview of empirical evidence on applied memory research. A final section will be concerned with a discussion of the adaptive functions of affective-cognitive behavior regulation and a prospect

on future directions of research. However, first of all, a brief look at the historical origins is in order to understand the broader issues that motivate contemporary research and theorizing.

## HISTORICAL PRECURSORS OF MODERN RESEARCH ON MEMORY AND EMOTION

In ancient philosophy (Plato) and the enlightenment (Kant, Schopenhauer) emotions were conceived as hard-to-control impulses that rational and ethical beings should learn to resist and to channel appropriately. This view on emotion as a rival of proper thought and veridical memory also underlies Freud's (1915/1957) psychodynamic approach to repressed and subliminal memories. In contrast to this negative image of emotions as causes of irrationality and affective disorder, Darwin's (1998) seminal writings (first published in 1872) were primarily concerned with valuable adaptive functions served by emotions. His "principle of serviceable associated habits" states that expressive movements that occur in emotion (like concealing movements in shame) are of "service" to the

organism. While these adaptive functions appear to be performed consciously, they can become routinized through habit and so firmly fixed that they are elicited automatically by the emotion-eliciting conditions (cf. Manstead, 2012), even when detached from their original purpose. This idea re-appears in contemporary research on mood priming suggesting that emotional states and even subtle emotional cues facilitate the processing of mood-congruent information.

Darwin's "principle of antithesis" states that emotion expression inhibits the expressive movements of opposing emotional states, thus invoking regulatory processes. A dog with hostile intentions, for instance, makes itself appear physically large in order to scare its rival. When the same dog in an affectionate state makes itself appear physically small, this only serves to accentuate the contrast of hostile and affectionate situations (Manstead, 2012). This example nicely illustrates the communicative and informative function of emotions that later became the focus of Schwarz and Clore's (2007) affect-as-information approach.

Darwin's third "principle of direct action of the nervous system," together with William James' (1884) idea that bodily reactions may precede the conscious experience of emotions, can be considered precursors of modern embodiment approaches (Damasio, 1994; Niedenthal, 2007). These approaches emphasize the importance of somatic experience and feelings in specific sensory modalities as mediators of affect and cognition.

Darwin (1998), McDougall (1908), and Watson (1919), who all stressed the universality of basic emotions (Tomkins, 1992), regarded emotions as distinct antecedent conditions that determine and delimit cognitive functions. In contrast, the soon arising constructionist approach (cf. Harlow & Stagner, 1933) assumed that cognitive constructions shape and mediate the genesis of emotions, as later articulated in Schachter's (1964) attribution theory. Today, a bi-directional causal assumption that cognition and emotion influence each other in multiple ways is

commonly taken for granted, motivating, for example, a rapidly growing research program on affective behavior regulation conceived as a dialectical interplay of cognitive, affective, and environmental influences on behavior (Gross, 2007; Koole, 2009).

## CONCEPTUAL AND TERMINOLOGICAL CONVENTIONS

There is wide consensus now to use the term "affect" as a generic, super-ordinate term for all kinds of affective processes and states. The term "emotion" refers to more specific affective states associated with particular emotion-eliciting stimuli. If the eliciting stimulus or situation is dangerous or threatening, the resulting emotion is anxiety or horror but not sadness or embarrassment.

In contrast, the term "mood" refers to more diffuse and enduring affective states. Moods are broader in meaning and not bound to specific eliciting stimuli, making them more likely to carry over to a broader class of situations and behavioral targets. A melancholic mood can taint the entire world with pessimistic connotations; an elated mood can cause generalized optimism. It is this broad meaning of mood states that justifies the crude distinction of "positive" and "negative" moods. Its unbounded independence of eliciting conditions creates the potential of moods to carry over to many real-life behaviors and judgment targets.

The term "feeling" finally refers to affective stimuli stemming from proprioceptive feedback, immediate body experience, or meta-cognitive monitoring of one's cognitive processes. The experience of facial or somatic muscle feedback is an example of a body feeling. Fluency or familiarity associated with recognition would be a cognitive feeling. Feelings may not be experienced consciously. Yet, even subtle and short feelings may be powerful enough to elicit similar behavioral effects as full-blown emotions or mood states.

## CLASSES OF EMPIRICAL FINDINGS

The vast majority of studies on affect, cognition, and behavior regulation (Blanchette & Richards, 2010; Gross, 2002; Martin & Clore, 2001; Taylor, 1991) are concerned with three broad classes of empirical phenomena:

1. Studies dealing with *valence asymmetries* often reveal a negativity bias, reflecting enhanced attention allocated to aversive or dangerous stimuli. However, many other studies exhibit a processing advantage of positive stimuli. Finding the crucial moderators of positivity and negativity effects presents a challenging theoretical and practical question.
2. Research on *mood-congruency* examines the interaction between stimulus valence and the individual's mood state. The generic finding is a processing advantage of information congruent with the individual's current emotional states; it can be found at all stages of cognitive processing, from attention and perception to encoding, inference making, retrieval, and resulting functions of judgment, decision making, and manifest behavior. The general idea is that positive affective states facilitate the processing of positive information, whereas negative affective states support the processing of negative information. The basic principle of mood congruency can also account for mood-state-dependency (Eich, 1989) as a special case, whereby the individual's affective state facilitates the recall of information that has been encoded in, and is thus associated with, the same affective state.
3. Different cognitive and behavioral styles are associated with positive and negative mood states. As a general rule, positive (happy, elated) moods foster top-down processing and knowledge-driven holistic and creative inferences, whereas negative (depressed, melancholic) states trigger stimulus-driven bottom-up processing and conservative inferences (Bless & Fiedler, 2006; Clore, Schwarz, & Conway, 1994). Processing requirements of the task therefore moderate the relation between affect and cognition.

## THEORETICAL CONCEPTIONS

Being able to account for these three major classes of empirical phenomena – mood

asymmetries, congruency effects, and mood-dependent processing styles – is a chief criterion for the viability of pertinent theories (cf. Martin & Clore, 2001).

Early approaches to deal with memory and emotion (cf. Bower, 1981; Isen, Shalke, Clark, & Karp, 1978) have adopted the theoretical metaphor of an associative network, trying to explain mood congruency in terms of spreading association. Assuming that activation emanating from mood-related nodes spreads over to concepts and stimulus nodes of the same affective tone seemed to offer a simple and straightforward explanation of mood congruency. However, although associative principles afford a necessary component of any comprehensive theory, the notion of an associative network cannot in and of itself explain the asymmetry of positive and negative affect, the direct, memory-independent influence of affect on social judgments, and the evidence on processing-style effects in different affective states.

Motivated by these limitations of purely associative accounts, the affect-as-information approach (Clore et al., 1994; Schwarz & Clore, 2007) was proposed to account for direct mood influences on social judgments in terms of a heuristic process. Survey respondents judged their life satisfaction to be higher on sunny than on rainy days, as if they were misattributing their current affective reaction to the weather to their life success (Schwarz & Clore, 1983). Reminding them of the weather as an external cause discredited the informative value of their affective state, thus eliminating its impact on life satisfaction and other judgment targets. Misattribution of extraneously caused affective states is a crucial condition of the mood-as-information conception.

This approach can be expanded to cover valence asymmetries and mood effects on cognitive style. Assuming that positive states signal benevolent situations and encouragement to “go,” whereas negative states signal danger and malevolent situations and warnings to “wait” or “stop” provides a natural account of the intuitive and creative style

observed in positive mood, as compared with the hesitating and conservative style in negative states.

We suggest an even broader and less restrictive theoretical framework that is consistent with most assumptions of the mood-as-information approach but distinct in its premises and its scope. Taking a functional-theory perspective (Bless & Fiedler, 2006; Fiedler, 2001), we interpret emotion and memory in terms of two complementary adaptive functions, *assimilation* and *accommodation*. As explicated by Piaget (1954), accommodation is a stimulus-driven bottom-up function that updates internal structures to cope with environmental chances and threats. Assimilation, in contrast, is a knowledge-driven top-down function that imposes internal structures (knowledge, inferences, goals) onto the external world, regardless of normative and ecological stimulus constraints.

Simply defining accommodation and assimilation as externally versus internally determined adaptation processes is slightly misleading, because both components are involved in all processing stages. The actual defining features of the two adaptive functions are summarized in Table 9.1. Accommodation is the degree to which performance on a task depends on accurate bottom-up processing of the given task input and the utilization of approved social and task-specific processing rules. Assimilation is the degree to which task performance may profit from top-down inferences that assimilate the given input to older knowledge structures, and the use of self-determined rules and operators that may deviate from normative rules.

Both components are to some degree involved in any cognitive operation, regardless of whether it is triggered by the

perception of the external world or memory of internally represented information. For example, reading involves stimulus-driven careful decoding of given letter strings (accommodation) but also knowledge-driven inferences and guessing strategies that go well beyond the decoded letters (assimilation). Yet, most tasks vary greatly in their relative emphasis on assimilation and accommodation.

Both adaptive strategies may be met with success (e.g., when accommodation results in accurate psychophysical estimates, or when assimilation produces a creative invention) or fail (e.g., when limited capacity prevents accommodation to stimulus details or when assimilation causes dysfunctional norm violations). Moreover, it may not always be possible to scale a set of tasks on both adaptive dimensions. However, whenever it is possible to order two or more tasks as relatively more accommodative or assimilative, the theoretical framework leads to clear-cut predictions concerning the influence of mood on memory.

The central assumption is that positive states (or affective cues) support assimilation whereas negative states (or affective cues) support accommodation. This assumption offers an immediate account for the different cognitive and behavioral styles triggered by different affective states or cues. Indeed, the terms “accommodative” and “assimilative” sound like phenomenological descriptions of the detailed and cautious style exhibited in negative mood and the unconventional and creative style exhibited in positive mood. Moreover, since mood congruency itself reflects an assimilative process (i.e., an assimilation of memory contents and target stimuli to the individual’s internal state),

**Table 9.1**

<i>Adaptive function</i>	<i>Information contents</i>	<i>Procedural rules</i>
Accommodation	Performance depends on accurate processing of given input ...	... and on utilization of approved social norms and task-specific rules
Assimilation	Performance depends on knowledge-driven inferences beyond the given input ...	... and on the use of self-determined operators that may deviate from existing norms

this framework offers a natural explanation for the asymmetrically stronger congruency effects in positive as compared with negative mood. With regard to valence asymmetries, it can explain why a negativity advantage during early perceptual stages (e.g., accommodation to input from a detection task) turns into a positivity bias in later stages involving knowledge-driven assimilative inferences.

Many implications of this theoretical framework are consistent with the predictions of the mood-as-information approach. Nevertheless, the assimilation-accommodation framework is less restrictive than, and its implications go beyond, the mood-as-information approach in several respects. The assimilation-accommodation framework is not confined to situations in which affect manipulations are subtle and equivocal enough to allow for affect misattribution. It does not exclude findings from many studies in which mood states can be obviously attributed to an external event or manipulation (such as film clips or failure). Moreover, it allows for congruency effects in genuine memory performance and not just heuristic response biases. It also offers an explanation for the empirical fact that congruency effects are clearly weaker or sometimes totally disappear in negative affective states, which is hard to reconcile with the notion that affective cues in general serve an informational function. The assimilation-accommodation framework predicts a number of processing-style effects that do not reflect an informative function of mood cues (like eliminated priming effects in negative mood; Storbeck & Clore, 2008). And last but not least, this framework implies that positive and negative affective states have similar influences as other factors that trigger assimilation and accommodation, such as high versus low construal level (Trope & Liberman, 2010), promotion versus prevention focus (Higgins, 2008), or familiar versus novel environments (Bischof, 1975). It therefore facilitates the theoretical interpretation

and integration of the affect-cognition link within a comprehensive meta-theoretical framework.

## REVIEW OF EVIDENCE

The empirical review presented in the remainder of this chapter will contain four major sections, devoted to social cognition, law, education, and regulation of affect and behavior. Each section will open up new fields of application but also introduce distinct theoretical ideas and empirical laws that are best explained in the specific applied context. The topic of the next section, social cognition, is ideally suited to present and explain the basic asymmetry of positive and negative affect. The section on eyewitness memory nicely illustrates the reconstructive nature of memory. Applications in the educational context highlight the important role of memory organization. Finally, health-related research speaks to emotion regulation processes and adaptive behavior.

### ***Social perception, social influence, and attitude learning***

A prominent theme in social-cognition research is valence asymmetries. Several theories stress the importance of recognizing negative stimuli faster than positive stimuli (Cannon, 1932; Taylor, 1991), and the higher weight given to negative than positive information in social judgment (Fiske, 1980; Fiedler, Walther, & Nickel, 1999; Skowronski & Carlston, 1989). Despite this vigilance for negative stimulation, people tend to think positively about themselves (Boucher & Osgood, 1969; Matlin & Stang, 1978; Taylor & Brown, 1988; Baumeister, Tice, & Hutton, 1989) and to avoid or ignore negative stimuli (Brandtstädter, Voss, & Rothermund, 2004; Voss, Rothermund, & Brandtstädter, 2008).

### *Mobilization and minimization*

In an influential model by Taylor (1991), this co-existence of negativity and positivity biases was explained as reflecting two processing stages. Attending to and detecting negative and potentially dangerous environmental stimuli is functional during an early mobilization stage, which serves an accommodative function. During a subsequent minimization stage, then, higher mental operations are employed to reduce the aversive stimulation and negative implications in an assimilative process.

### *Early negativity effects*

Using a Stroop-like task involving color naming of adjectives, Pratto and John (1991) provided strong evidence for automatic vigilance, a stimulus-driven mechanism that automatically directs attention to unpleasant stimuli. The time required to name the ink color of a stimulus word was longer for negative than for positive words, presumably because negative stimulus contents interfere with color naming. Furthermore, participants showed more frequent incidental learning of negative compared with positive stimuli. Despite this attention-grabbing power of negative stimuli, it is however possible that negative stimuli are inhibited from entering consciousness (Holmes, 1974, 1990), as evident in perceptual defense or repression. For instance, baseball fans remember success of their team more vividly than failures (Breslin & Safer, 2011).

Asymmetries of positive and negative valence have also been studied in the face-in-the-crowd paradigm, in which participants have to detect a distinct target face embedded in a matrix of distracter faces. Several studies seemed to demonstrate a recognition advantage of angry faces embedded in a set of otherwise positive faces. Because the time needed to find a friendly face increased with display size whereas recognition time for threatening faces was unaffected, the negative superiority was interpreted as an automatic pop-out effect (e.g., Hansen & Hansen, 1988; Öhman, Lundqvist, & Esteves, 2001;

but see Juth, Lundqvist, Karlsson, & Öhman, 2005; Purcell, Stewart, & Skov, 1996).

### *Negativity effects revisited*

Closer inspection and more refined study designs revealed that the evidence for a negativity effect on selective attention tasks is less clear-cut than expected from Pratto and John (1991). Using the drift-rate parameter in diffusion analysis as a measure of cognitive-processing speed in a speeded classification task with bi-colored geometric figures, Voss et al. (2008) found that colors associated with losses were processed slower than colors associated with gains. Other research suggests that Pratto and John's (1991) negativity advantage may be peculiar to enhanced arousal of negative stimuli (Keil & Ihssen, 2004; Schimmack, 2005), or to highly anxious participants (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007).

Recently, more refined study designs controlled for confounding perceptual features like the V-shape of angry eyebrows or white teeth in smiling faces that may be responsible for conflicting results in face-in-the-crowd research (see Becker, Anderson, Mortensen, Neufeld, & Neel, 2011). Contrary to the seemingly well-established anger-superiority effect, the positive faces enjoyed a processing advantage. Moreover, there was no evidence for a pre-attentive popping-out of angry faces, as the latencies needed to discover angry faces in the crowd were not invariant when the size of the face matrix was manipulated. Instead, Becker et al. (2011) found that the fast processing of happy background faces can explain the often cited fast recognition of angry target faces.

The evidence for a positivity bias in the face-in-the-crowd paradigm is consistent with other recent findings motivated by the density hypothesis (Unkelbach, Fiedler, Bayer, Stegmüller, & Danner, 2008). Based on the central assumption of higher density and greater interconnectedness of positive than negative stimuli in memory, several studies have found faster speeded classification and

stronger affective priming effects for positive than for negative stimuli. Moreover, the strength of these effects could be predicted by the density value of particular stimuli, as assessed through multi-dimensional scaling.

As a rule, the minimization of hedonically unpleasant stimuli increases to the extent that the task conditions allow for assimilative inferences, reframing, and self-determined interpretation. Granting sufficient meta-cognitive control, negative experiences may be prevented strategically or ignored deliberately (e.g., Brandtstädter et al., 2004) to shield the self from unpleasant feedback and devaluation (e.g., Taylor & Brown, 1988; Baumeister et al., 1989; for a comprehensive review, see Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001). Complementary, the generalized preference for positive ideas and conclusions – the so-called Pollyanna principle (Matlin & Stang, 1978) – is, for example, reflected in higher occurrence rates of positive than negative words in language (Boucher & Osgood, 1969).

### *Formation of attitudes*

Valence asymmetries have also been found in the formation of attitudes. The tendency to avoid unpleasant stimuli can produce a negativity bias when information sampling from aversive sources is truncated so that negative initial impressions or stereotypes cannot be corrected (Denrell, 2005; Fazio, Eiser, & Shook, 2004). As a consequence of the minimization of negative input through selective avoidance, the low frequency of occurrence renders negative behaviors more diagnostic than positive behaviors (Ajzen, 1971; Eisinger & Mills, 1968). Thus, observing somebody lying on a single occasion has more impact on the belief that the person is dishonest than a single instance of telling the truth has on the belief that the person is honest (Skowronski & Carlston, 1989). Because of this epistemic asymmetry, negative observations trigger deeper processing and receive more weight in attitude formation and social judgments than positive observations (Fiske, 1980).

Evaluative conditioning is an experimental analog of attitude learning, whereby the mere co-occurrence of neutral, conditioned stimuli (CS) and valence-laden, unconditioned stimuli (US) leads to a shift in the evaluation of the CS toward the same valence as the US. Evaluative conditioning is particularly relevant to applied research on stereotyping, prejudice, or consumer settings, in which products are presented together with pleasant stimuli like celebrity endorsers. This paradigm often produces stronger conditioning effects after negative than after positive pairings (Baeyens, Eelen, & van den Bergh, 1990; Hütter, Sweldens, Stahl, Unkelbach, & Klauer, 2012; Levey & Martin, 1975). Moreover, when the valence of the US changes after the conditioning procedure (US revaluation), the CS is also affected but more so after negative than positive US revaluation (Walther, Gawronski, Blank, & Langer, 2009).

Negative evaluations thus appear to be more persistent and to have higher impact than positive evaluations. Hence, evaluative conditioning constitutes a largely accommodative, stimulus-driven process that may, however, be modulated by assimilative processes. Direction and size of conditioning effects depend on the self-generated relations between CS and US. For example, when facial stimuli allow participants to construe a friend-relation between CS and US, a regular EC effect is evident in CS taking on the same valence as US. However, pairing the same stimuli can induce a CS valence opposite to the US valence when the two faces are construed as belonging to enemies (Fiedler & Unkelbach, 2011).

### *Measurement of attitudes*

Direct questionnaire measures of attitudes have been criticized as being prone to Pollyanna effects and motivated biases toward positive self-representation. As countermeasures to deal with these problems, indirect measures have been proposed that allow for less assimilation and rely instead on more accommodative, stimulus-dependent speeded



classification and approach-avoidance tasks. Prominent examples are implicit association tests (Greenwald, McGhee, & Schwartz, 1998), affective priming (Fazio, Sanbonmatsu, Powell, & Kardes, 1986), or simple motor tasks that call for pulling (approach) or pushing (avoidance) motor responses (e.g., with a joy stick; Brendl, Markman, & Messner, 2005) relative to attitude objects presented on a computer screen. Recent evidence suggests, though, that such indirect measures are also subject to more voluntary and strategic control than expected (De Houwer, 2001; Fiedler, Bluemke, & Unkelbach, 2009; Teige-Mocigemba & Klauer, 2008).

### *Social judgment*

The social judgment literature is replete with mood-congruency and processing-style effects in such diverse paradigms as person perception, stereotyping, persuasion, self-related judgments, cooperation, and deception. Mood-congruency effects were found in autobiographical memory (Salovey & Singer, 1989), memory for flavor (Pliner & Steverango, 1994), evaluations of consumer items (Forgas & Ciarrochi, 2001), confabulations of patients (Bajo, Fleminger, & Kopelman, 2010), reactions to (im)politeness (Forgas, 1999), interpretations of relationship conflicts (Forgas, 1994), evaluations of commercials (Kamins, Marks, & Skinner, 1991), and judgments of life satisfaction (Schwarz & Clore, 1983; Strack, Schwarz, & Gschneidinger, 1985). These congruency effects tend to be much stronger for positive than negative affect, consistent with the fact that mood congruency is an assimilative function fostered by positive mood. Moreover, the likelihood and strength of congruency effects increases when memory or the judgment task is unrestricted and constructive (Forgas, 1995), that is, the more room there is for assimilation.

Processing style effects are reflected in stronger top-down influences in positive mood but stronger bottom-up influences in negative mood. In positive compared with negative mood, people are more prone to

make stereotypical judgments (Bodenhausen, 1993; Bodenhausen & Lichtenstein, 1987), to follow trust expectancies (Lount, 2010), to rely on guessing based on scripted knowledge (Bless, Clore, Schwarz, Golisano, Rabe, & Wolk, 1996), to generate false memories (Storbeck & Clore, 2005), to use abstract rather than concrete language (Beukeboom & Semin, 2006), to profit from self-generation effects in learning (Fiedler, Nickel, Asbeck, & Pagel, 2003), to flexibly attend to global or local stimulus aspects (Huntsinger, Clore, & Bar-Anan, 2010), and to produce group-polarization effects (Forgas, 1999).

### *Persuasion*

Several experiments have tested the impact of mood on recipients processing styles in persuasive communication. For instance, Bless, Bohner, Schwarz, and Strack (1990) had their participants write a report on a happy or a sad life event for mood manipulation. They were then presented with a persuasive message advertising an increase in student service fees that either contained weak or strong arguments. Participants in sad mood were persuaded by cogent arguments but disapproved of weak arguments. When participants were in elated moods, argument quality had little influence. While this insensitivity to message quality was often attributed to lower effort expenditure in positive mood, further analyses showed that the number of cognitive responses was not reduced in positive mood. Given that the manipulation of argument strength was not based on logical or empirical truth but on consensual agreement, another plausible explanation is that recipients in positive mood were less conformist and less dependent on majority opinions.

Consistent with this notion, Ziegler and Diehl (2011) found that, relative to negative mood, positive mood led to deeper processing of arguments provided by minorities (versus majorities) and by untrustworthy (versus trustworthy) sources. Open-mindedness and independence of conformist norms is a typi-

cal property of an assimilative processing style in positive mood. Another property is taking the freedom to follow one's hedonic goals. Central to Wegener and Petty's (1994) hedonic contingency model, indeed, is the assumption that people in positive mood may simply not process unpleasant arguments that might interfere with their elated affective state.

### ***Eyewitness-memory and face recognition***

Human memory is crucial and consequential when court trials have to rely on eyewitness testimony, in the absence of physical proofs of the defendant's guilt or innocence. It is thus no surprise that eyewitness memory is one of the most important domains of applied memory research. Numerous DNA exoneration cases – convicted people whose innocence was later proven through DNA analysis – testify to the fallibility of human memory as a major cause of false convictions (Wells, Malpass, Lindsay, Fisher, Turtle, & Fulero, 2000). Given the intense emotions experienced by many witnesses of crimes, the impact of emotional states on eyewitness memory constitutes a prominent research topic.

#### ***Face recognition***

A recognition test that calls for accurate discrimination between actually presented stimuli and a large number of foils constitutes an accommodative task: sticking to the stimulus input, which must not be confused with assimilative inferences that go beyond the information given. Consistent with the notion that negative affective states support accommodation, negative mood during encoding was found to facilitate the discrimination of faces in a recognition test (Hills, Werno, & Lewis, 2011; Teitelbaum & Geiselman, 1997). Positive mood again led to a congruency bias toward remembering happy faces better than sad faces (Hills et al., 2011), reflecting the selective elaboration of mood-congruent faces.

The assimilative encoding style in positive mood also fosters holistic encoding. Participants in a study by Bridge, Chiao, and Paller (2010) read happy or sad narratives while viewing the faces to be remembered later. During recognition, the encoding context was either retained or obscured (by presenting the faces in an inverted spatial orientation). Consistent with the notion that positive affect facilitates deep contextualized encoding of holistic information, conceivable as assimilative encoding, Bridge et al. (2010) found better recall of faces encoded in happy settings when the context was retained. However, a recognition advantage of faces encoded in sad settings was obtained when the context was obscured so that recognition decisions had to rely on accommodative encoding of concrete physiognomic features of the original stimulus faces proper.

#### ***False memories***

One intriguing implication of a more assimilative, holistic, and top-down driven processing style is that positive (compared with negative) mood should produce more false memories (Roediger & McDermott, 1999). When presented with a recognition probe that was not included in the stimulus list but that bore a strong relation to the semantic theme of the list, people in positive mood should be more likely than people in negative states to make constructive errors. Moreover, assimilative response sets should induce higher confidence under positive mood than accommodative response sets under negative mood. Both predictions were supported by Storbeck and Clore (2005).

Applying the same rationale to eyewitness reports, a more liberal response bias that is typical for positive mood should increase the incorrect recognition of non-experienced lures (false alarms), even when correct recognition of actually experienced stimuli (hits) may also profit from positive affective cues. Because eyewitness recognition suffers from too liberal a response bias, the net result should be impaired eyewitness performance (due to mainly false positives)

in positive mood. Support for this contention was found by Forgas, Laham, and Vargas (2005) in a study of eyewitnesses' verbal reports. Participants in positive mood incorporated more false positives in their reports than participants in negative mood.

### *State dependency*

An eyewitness study conducted by Rainis (2001) speaks to the impact of mood-state-dependency on face recognition (Eich, 1989). Re-establishing a similar affective state at recognition as during the original observation stage improved the accuracy of eyewitness testimony. The affective influence on memory was again enhanced in positive affective states. Recognition of faces encoded in negative states was generally weak, presumably because the highly aversive pictures used to induce negative affect (depicting concentration camps or road accidents), presented in the same modality as the stimulus faces, interfered with an efficient encoding process, consistent with Taylor's (1991) minimization principle. Indeed, when affective recognition states were induced semantically rather than pictorially, a state-dependent memory advantage was also observed for negative affect. Thus, creating a matching "semantic context" seems to afford a useful remedy to emotional stress, compensating for the impairment of emotional distracters.

### *Memory for affectively extreme stimuli*

In the eyewitness literature, it is commonly presupposed that memory for highly aversive and stressful events is impaired. The available evidence, however, is less clear-cut (Christianson, 1992). On the one hand, the inverted U-shape of the Yerkes–Dodson law predicts that witness performance first increases from low to medium arousal and then decreases when arousal becomes too strong (Teigen, 1994). An accommodative focus on danger and threat interferes with context memory (Christianson & Loftus,

1991; Ochi, 2005). On the other hand, affectively intensive experiences may produce strong and enduring flashbulb memories (Winograd & Neisser, 1992), which are also reflective of accommodation. Whether strong affect improves or impairs subsequent memory depends on several boundary conditions, such as the encoding context, the type and delay of the memory test, and the amount of detail required (cf. Christianson, 1992).

The phenomenon of repressed memories (Loftus, Garry, & Hayne, 2008) supports this hybrid message. On the one hand, the incisive experience of being raped or abused is unlikely to be forgotten. On the other hand, it is claimed that extremely threatening and intolerable experiences may be actively purged or blocked from consciousness. However, there is hardly any cogent evidence for the validity of this widely shared claim about amnesia for threatening events (Loftus et al., 2008; Rofé, 2008), beyond the well-established general evidence for inferior recall and recognition of unpleasant events (Depue, Curran, & Banich, 2007; Erdelyi, 2006).

The lack of evidence for complete repression of incisive autobiographical episodes is compatible with the finding that intense negative affect may reduce memory for real crimes (Ihlebaek, Løve, Eilertson, & Magnussen, 2003). To study the impact of relatively high degrees of fear, Valentine and Mesout (2009) assessed heart-rate changes and questionnaire measures of state anxiety in visitors to the horror labyrinth of the London Dungeon. Dependent measures were cued-recall of descriptive attributes of the scary person in the horror labyrinth (sex, age, height, hair color, clothing, etc.) and identification of the scary person in a nine-person photo line-up. High-state anxiety led to a marked decrease in memory performance, as manifested in fewer correctly reported person descriptors, more incorrectly reported details, and fewer correct identifications.

### ***The role of affect in academic learning***

Theoretically, the relationship between positive versus negative mood and task-related performance and motivation should depend on the relative degree to which a task calls for accommodation and assimilation. Negative mood should enhance performance when the task requires accommodation, careful assessment of stimulus details, and conservative response strategies. In contrast, positive mood should facilitate performance on assimilative tasks that invite holistic and intuitive processing, unorthodox creativity, and liberal response strategies.

Indeed, a negative-mood advantage was found for learning tasks involving careful attention and thorough processing, such as correlation judgments from scatter diagrams (Sinclair & Mark, 1995), recognition accuracy (Storbeck & Clore, 2005), and careful consideration of all possibilities in reasoning tasks (Oaksford, Morris, Grainger, & Williams, 1996). A positive-mood advantage, in contrast, was obtained in assimilative tasks involving creativity (Baas, De Dreu, & Nijstad, 2008), memory organization (Bless, Hamilton, & Mackie, 1992), top-down processing (Lee & Sternthal, 1999), developing trust (Lount, 2010), and intuitive inferences from small amounts of information (Fiedler, Renn, & Kareev, 2010).

### ***Episodic memory for words and pictures***

In the academic-learning realm, too, the relative advantage of positive and negative mood should depend on the degree to which the learning task involves careful conservation of stimulus details and/or creative elaboration and generative inferences. Thus, a negative-mood advantage can be expected for reproductive tasks, such as learning of vocabulary or historical dates, monitoring of orthography and grammar, or careful numerical calculation. However, because even basic mental operations rely on active

elaboration and idiosyncratic integration (Mandler, 2011), it is no surprise that learning can greatly profit from the assimilative functions fostered by positive moods. A key finding here is that positive mood facilitates clustering of categorized coding of stimulus lists (Fiedler, Pampe, & Scherf, 1986; Lee & Sternthal, 1999), which is crucial to effective retrieval. Positive mood also enhanced the speed and accuracy of mathematical thinking (Bryan & Bryan, 1991), whereas the conservative style of students in negative mood restricted the learning transfer to new situations (Brand, Reimer, & Opwis, 2007).

### ***Creativity and problem solving***

Mental operations are called creative if their output is substantially different from the task input, reflecting an assimilative transformation that goes beyond the mere (accommodative) conservation of the information given. Not surprisingly, therefore, positive mood was found to foster creative performance on many different tasks. In a study by Isen, Daubman, and Nowicki (1987), for instance, positive mood decreased the time required to solve Duncker's candle problem, a "classical" task to assess the ability to overcome functional fixedness (discovering that matchboxes can also be used to construct a platform on the wall). Analogous findings were obtained for many other operational measures of creativity. For instance, positive mood led to more original, uncommon responses to verbal association tasks (Isen, Johnson, Mertz, & Robinson, 1985), according to association norms. Or, Rowe, Hirsh, Anderson, and Smith (2007) reported that positive mood enhanced performance on a remote association test, due to loosened reins on inhibitory control resulting in increased breadth of attention allocation.

A meta-analysis by Baas et al. (2008) corroborated and refined this contention. Creativity was most enhanced in positive states that foster approach tendencies and promotion focus (e.g., happiness), but not

in positive states that lack these assimilative functions (e.g., relaxation). Creativity decreased in negative states that trigger avoidance and prevention focus (fear, anxiety). Less accommodative negative moods (e.g., sadness) did not affect creativity.

### ***Adaptive functions of cognitive-emotional regulation***

The adaptive regulation of behavior depends on a twofold – informational and motivational – function of affective states. People use their momentary affective states as information about the world. They utilize their mood resulting from sunny or rainy weather to estimate their life satisfaction (Schwarz & Clore, 1983). But moods also contribute to ending unpleasant and dysfunctional affective states and to re-establishing healthy and motivating states. In good mood people strive for mood maintenance whereas in sad mood they make every effort to repair or terminate their unpleasant state (Baumeister, Heatherton, & Tice, 1994). Maintaining positive mood not only serves a hedonic function. According to the mood-as-a-resource hypothesis (Aspinwall, 1998; Trope & Neter, 1994), it also functions as a buffer against short-term affective costs of negative information in favor of long-term gains.

### ***Affective priming and short term processes triggered by affective cues***

Mood effects can be elicited not only by hedonically significant events but also by subtle, short-term affective cues. One experimental paradigm to investigate the adaptive functions of affective cues is affective priming (e.g., Fazio et al., 1986; Klauer, 1998; Klauer & Musch, 2003). In this paradigm, participants have to evaluate positive and negative targets preceded by positive or negative primes. If prime and target match in valence, the response to the target is typically facilitated (*congruent* condition). If they

differ in valences, responding to the target can be decelerated (*incongruent* condition).

Priming can be regarded as an experimentally induced assimilation effect, whereby the prime initiates a top-down expectancy that influences the accommodative response to the target stimulus. Consistent with this notion, priming effects are enhanced in positive mood (Bless & Fiedler, 1995) and may be completely eliminated in negative mood (Storbeck & Clore, 2008). Similarly, stronger flanker effects were found in positive than in negative mood (Rowe et al., 2007). The flanker task is to categorize a central stimulus (e.g., < or >) flanked by matching or mismatching context stimuli (e.g., > > < > or > > > >). As in priming response latencies are typically shorter for matching trials. Although priming is considered adaptive but flanker effects as impairment, they both reflect similar assimilative functions.

The asymmetry of positive and negative affect in evaluative priming is even visible at the level of individual trials. When latencies (and accuracies) for specific trial pairs were reported, the valence–congruity advantage was mainly due to positive–prime–positive–target trials but hardly visible for negative–negative trials (Fiedler, Bluemke, & Unkelbach, 2011; Unkelbach et al., 2008). Thus, the congruity effects elicited by short-term affective cues (i.e., primes) resemble those elicited by the participants' long-term affective states.

Asymmetric priming effects have been related to the regulation of well-being and health. Robinson and von Hippel (2006) demonstrated that stronger positive than negative priming effects are indicative of high life satisfaction. Other recent publications point toward the potential use of affective priming in the context of therapeutic interventions (Evans, 2010; Bargh & Shalev, 2012). The idea underlying these claims is that affective priming in clinical settings can serve to heighten clients' temporary mood and their receptiveness for treatment and that priming-based interventions can be carried out unobtrusively, at minimal reactance.

## CONCLUSION

The empirical findings and theoretical insights we have presented in this chapter do not provide a comprehensive review of all published research on emotion and memory. Following Kurt Lewin's maxim that there is nothing more practical than a good theory, we have concentrated on those aspects of applied memory research that reflect the adaptive functions of the individual's affective states. In doing so, we have found, conversely, that applied memory studies provide impressive convergent evidence for the notion that the complementary functions of assimilation and accommodation afford a sensible theoretical framework for the integration of research on emotion, memory, and behavior regulation.

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