Educational settings are replete with affective experiences, anxiety and fun, frustration and fulfillment, disappointment and pride. The relationship between affect and cognition is bidirectional. On the one hand, emotions are results of appraisal of academic success and failure, of pleasant or unpleasant personal and social experiences in educational encounters. On the other hand, learners’ emotions energize but also restrict their achievement and achievement motivation. In the first two decades of most people’s lives, educational settings are one of the most important sources of affective experience. Similarly, teachers’ affective states are influenced by their success and failure in teaching, and these states in turn moderate their evaluations and attributions and impact their teaching behavior.

Although affect and cognition can influence each other in either direction, the vast majority of pertinent studies are concerned with influences of emotional states on cognitive and motivational functions. Evidence for the reverse influence of cognitive operations on emotional outcomes is largely confined to correlational evidence on appraisal influences, which is the topic of Chapters 6 and 7 (Graham & Taylor, 2014; Pekrun & Perry, 2014). Nevertheless, a growing interest in the investigation of affect regulation, conceived as a dialectical interplay of mental and emotional processes and behavioral outcomes, highlights the need to study all functions subserved by emotions in educational settings, be it as independent, dependent, or mediating variables.

**TERMINOLOGY AND CONCEPTUAL EXPLICATIONS**

Just as the affect–cognition interface can be approached from different perspectives, the educational domain can be defined in more or less restrictive ways. More specifically, the term education may refer to the cognitive process of learning and knowledge acquisition.

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at school and in academic settings. Much more generally, though, education can also be conceptualized in a broad sense, referring to all kinds of social-learning and socialization mechanisms that together shape the socialization process, including the acquisition of moral, social, and cultural norms, attitudes, and habits. Research on affect and cognition has led to rich evidence and valuable insights at both levels of education, referred to as academic learning and socialization, respectively.

Types of Affective States

With regard to the terminology used to denote affective states, there is now wide agreement to distinguish between specific emotions and more diffuse mood states. Emotions are bound to specific eliciting stimuli and characterized by situation-specific appraisal functions. For instance, embarrassment is an emotion elicited by failure experience or revelation of intimate secrets but does not fit a frustrating or provocative situation. As a consequence, emotions are bound to a specific stimulus context and therefore unlikely to carry over to many other stimulus contexts. Moods, in contrast, are unspecific, typically quite enduring affective states, with often indeterminate origins. When people are in an elated or melancholic mood state, the origin or eliciting experience is often unknown, and maybe attributed to a wrong cause. Because of this unbounded, stimulus-independent nature, mood states are more likely to generalize over time and situations and are more difficult to evade or control than distinct emotions. While research on mood has been largely confined to one-dimensional comparisons of positive and negative states, more dimensions are needed to represent the qualitatively different contrasts that have been the focus of emotion research.

A prominent topic in recent research on metacognition (Schwarz & Clore, 2007) and embodiment (Niedenthal, 2007) are feelings. These affective states can be characterized as nonpropositional cues or signals that impact regulation functions. For instance, fluency is a cognitive feeling that signals flow and absence of obstacles or difficulties, whereas disfluency signals problems or sources of resistance that need to be tackled (Oppenheimer, 2008). The empirical study of feelings highlights the fact that subtle affective cues, or primes, may serve similarly important functions for the regulation of behavior as intensive moods or acute emotional reactions, particularly in the domain of learning and education (Koriat & Bjork, 2005). Finally, the term affect is used as a superordinate concept that covers all experientially nonneutral, hedonic or value-laden states or stimuli.

Chapter Preview

Providing a comprehensive review of the huge literature on affect and cognition would exceed the scope of this chapter. Its aim is rather to present a sensible but necessarily selective overview of findings that should meet two criteria. The reported evidence should be both practically useful and theoretically meaningful. In the absence of a sound theoretical framework to explain the reported evidence, it would be impossible to evaluate the validity, the limits, and the practical value of any empirical findings.

Therefore, the purpose of the next section is to outline a basic theoretical framework within which the interplay of emotional and cognitive processes can be understood. While this theoretical outline will draw on illustrative examples of educational behavior, another section will then be devoted to a broader review of convergent evidence. This major section will be subdivided into several subsections dealing with more specific
research topics. Starting with an overview of the impact of positive versus negative mood on learning and memory, we will then examine the trade-off between reproductive (conservative) and productive (creative) cognitive functions, and we will also briefly point out distinct appraisal functions and the cognitive consequences of more specific emotions, beyond the mere distinction of positive and negative mood. (For a more comprehensive treatment of appraisal functions and appraisal theories, the reader is referred to Chapters 6 and 7; Graham & Taylor, 2014; Pekrun & Perry, 2014.) A final section will deal with research on affective behavior regulation, highlighting the basic insight that no particular emotional state is generally optimal for learning, education, and subjective well-being but that adaptive behavior calls for varying cognitive strategies and contrasting emotions rather than optimization of constant strategies and hedonic states.

**OUTLINE OF A THEORETICAL FRAMEWORK**

*Two Basic Adaptive Functions: Accommodation and Assimilation*

Central for understanding the interaction between affect and cognition is the analysis of adaptive behavior in terms of two distinct adaptive functions, accommodation and assimilation, with the terms borrowed from Piaget’s (1954) theory of cognitive development. Accommodation refers to adaptive adjustments of the individual’s internal representations to the external constraints imposed by the stimulus environment. Assimilation refers to the complementary process of adjusting (i.e., assimilating) the external world to the individual’s internal structures. Accommodation can be characterized as a stimulus-driven bottom-up process that aims at reacting as sensitively as possible to new environmental data—that is, to the signals, threats, challenges, and opportunities of ongoing adaptation tasks. In contrast, assimilation is a knowledge-driven top-down process whereby the individual relies on his or her own theories in going beyond the given stimulus data to predict, explain, and control the external world. In other words, accommodation is essentially reproductive and conservative whereas assimilation is productive and generative.

Both functions are not mutually exclusive processing modes but complementary aspects that are jointly involved in all adaptive behavior. Every social or intellectual task calls for some degree of adherence to the constraints of the situation and the stimulus input (accommodation) but also some creative transformation of the given input into some new output, or solution, based on the individual’s internalized knowledge, motives, and behavioral repertoire (assimilation). To solve a mathematical task means to keep the task instructions and the input text and data in memory, as a precondition for any reasonable response that might transform the input task into some creative output solution. Even a seemingly reproductive task as reading involves both stimulus-driven decoding of written text and knowledge-driven inference making and hypothesis testing.

However, while both adaptive functions are universal and mutually complement and constrain each other, the relative contribution of accommodation and assimilation can vary considerably across tasks. When conservative or reproductive tasks call for careful bottom-up assessment of all stimulus details, sticking to externally given facts and refraining from uncertain inferences, the emphasis is on accommodation. In contrast, success on creative or productive tasks depends on innovative interpretations, constructive top-down inferences, and creative enrichment of the information given, thus relying heavily on assimilation.
Crucial to understanding the role of affect in learning and education is the assumption that negative affective cues and moods support accommodation, whereas positive affect supports assimilation functions. This general rule received support from countless empirical studies. Negative affective states have been regularly shown to facilitate careful stimulus processing (Forgas, 1998), selective attention to task-relevant stimuli (Rowe, Hirsh, Anderson, & Smith, 2007), avoidance of careless mistakes (Sinclair & Mark, 1995), concrete and detailed representations (Beukeboom & Semin, 2006), discrimination of strong and weak arguments (Bless, Bohner, Schwarz, & Strack, 1990), and adherence to social and moral norms (Forgas, 1999). In contrast, positive affective states facilitate constructive inferences (Storbeck & Clore, 2005), priming effects and heuristic judgments (Storbeck & Clore, 2008), creative problem solving (Isen, Daubman, & Nowicki, 1987), stereotyping (Bodenhausen, 1994), flexible representations (Huntsinger, Clore, & Bar-Anan, 2010), and spontaneous and norm-independent behavior (Forgas, 1999).

While mood states may also affect the amount of available cognitive resources (Pekrun, 2006), this influence can operate in both directions: both the consumption of positive mood states (Mackie & Worth, 1989) and the administration of negative moods (Ellis & Ashbrook, 1988).

**Affective States as Causes and Catalysts of Learning**

As a consequence, there is no one-sided answer to the frequently asked question of whether learning is generally more effective in positive or negative emotional states. The answer depends, rather, on the type of learning task. As a general rule, task-specific performance can be expected to profit from negative states on accommodative (conservative stimulus-driven bottom-up) tasks and from positive states on assimilative (creative knowledge-driven top-down) tasks. Moreover, successful learning and development in the long run is a function of optimal variation between both stages of the creative cycle (Fiedler, 1988, 2001a; Kelly, 1955). On the one hand, “loosening” stages serve the assimilative function of broadening one’s behavioral repertoire through exploration and creation of new ideas, analogous to the role of (random) variation in evolution. On the other hand, “tightening” stages serve the accommodative function of selecting and maintaining the most effective and least error-prone exemplars.

**Affective States Resulting From Learning Experience**

Affective states not only function as independent variables that motivate and facilitate learning processes, but they also appear as dependent variables that reflect the appraisal of success versus failure, or pleasant versus unpleasant outcomes of learning tasks. Indeed, (alleged) performance feedback is an effective means for the experimental induction of positive or negative mood states (Alter & Forgas, 2007). Similarly, disapproval and social exclusion (ostracism; Williams & Nida, 2011) have been shown to be a potent source of negative mood, whereas approval and social support induce happiness and life satisfaction (Kasprzak, 2010).

One intriguing implication of the adaptive-behavior framework is that the bidirectional causal relationship between affective influences on learning and learning on affect typically results in regulatory cycles. The assimilation effects of positive moods (e.g., enterprising exploration, impoliteness, constructive inferences) often raise the likelihood
of errors, unwanted consequences, and negative social reactions that will down-regulate mood to more negative states. Conversely, the accommodative strategies, characteristic of negative states (e.g., careful stimulus monitoring, norm-adherence, refraining from idiosyncrasies), contribute to mood repair and upward regulation. Thus, ironically, the explorative and creative style fostered by positive mood entails the potential for mood impairment, and the cautious and compliant style in negative mood entails the potential for mood repair (Fiedler, 1988). To be sure, this is not to say that all feedback loops will reverse the current mood.

**EMPIRICAL EVIDENCE RELATING MOOD TO COGNITION, BEHAVIOR, AND MOTIVATION: IMPACT OF POSITIVE AND NEGATIVE MOOD ON LEARNING**

Fundamental research on learning and memory in laboratory settings reveals that, compared to positive mood, negative mood leads to increased accuracy (Forgas, Goldenberg, & Unkelbach, 2009), careful responding (Sinclair, 1988), and decreased heuristic mistakes (Bodenhausen, 1994; Koch & Forgas, 2012; Park & Banaji, 2000). These advantages are evident on accommodative tasks demanding discipline and careful stimulus processing. Conversely, the relative advantages of positive mood are visible on assimilative tasks that call for creative solutions (Isen et al., 1987), knowledge-based organization (Bless, Hamilton, & Mackie, 1992), self-generated inferences (Fiedler, Nickel, Asbeck, & Pagel, 2003), and selective forgetting as a precondition of the controlled acquisition of new knowledge (Bäuml & Kuhbandner, 2007).

The same basic pattern is obtained in actual academic-learning settings or in experimental tasks that resemble educational learning situations. Consistent with the notion that negative and positive affective cues function like stop and go signals (Clore, Schwarz, & Conway, 1994), several studies found that people in a positive mood make more errors than people in a negative mood on misleading tasks with high rates of premature responding. Using standard reasoning tasks, such as the Tower of London and the Wason selection task, Oaksford, Morris, Grainger, and Williams (1996) showed that mood states generally interfered with working memory capacity. However, the resulting performance suppression was stronger for positive than negative mood, as manifested in a more pronounced confirmation bias to respond positively to wrong solutions that ought to be rejected.

Conceptually, very similar results have been obtained in the false-memory paradigm (Forgas, Laham, & Vargas, 2005; Storbeck & Clore, 2005). Using a task created by Roediger and McDermott (1995), participants were presented with word lists in which various words (e.g., bed, pillow, rest, awake, dream) were related to a critical one (sleep) that was, however, not included. In a subsequent memory test, these critical lures are typically remembered equally well or even better than the actually presented stimuli. Storbeck and Clore (2005) found more false-memory effects in positive mood and, hence, higher accuracy under negative mood. However, inaccuracy on such a task only reflects the deeper assimilative processing of the stimulus lists by people in positive mood, whose false memories may also be interpreted as strong memories for self-generated information.

Consistent with this interpretation, the so-called generation effect—that is, the enhanced memory for self-generated as compared to externally provided information,
was repeatedly shown to be stronger under positive than negative mood (Bless & Fiedler, 2006; Fiedler, 2001a). In a series of experiments by Fiedler et al. (2003), happy and sad participants who had been exposed to funny or sad film clips, respectively, received extended lists of positive and negative words. These either appeared in a complete format and only had to be read or in a degraded format with several missing letters, so that the word meaning had to be generated actively. As usual in this paradigm, which highlights the crucial role of active encoding for academic learning (Bjork, 1994; Metcalfe, 2009), subsequent free recall was higher for generated than for merely read words. However, crucially, the generation advantage was systematically stronger in positive than in negative mood, apparently because memory profits greatly from assimilative elaboration during learning.

In a related vein, positive mood was shown to facilitate the formation of knowledge-based memory for scripted behavior presented in narratives (Bless, Clore, Schwarz, Golisano, Rabe, & Wolk, 1996), for tightly organized, categorized lists (Fiedler, Pampe, & Scherf, 1986), and for spontaneous category learning (Nadler, Rabi, & Minda, 2010). The latter authors reasoned that the increased flexibility of people in a positive mood is associated with the prefrontal cortex and the anterior cingulate cortex. As both brain locations play crucial roles in rule selection, the authors instructed participants in positive, neutral, or negative mood states to learn either rule-based or nonrule-based category sets. Consistent with their hypothesis and with the notion that positive mood facilitates creative top-down hypothesis testing, Nadler et al. (2010) found that participants in a positive mood performed better than subjects in a neutral or negative mood in classifying stimuli from rule-described categories, but not from arbitrary, rule-independent categories.

MEMORY ORGANIZATION AS A KEY TO EFFECTIVE LEARNING

Thus, whether negative or positive mood produces better learning depends on the extent to which either given associations or new organization is the key to good learning and performance (cf. Mandler, 2011). Careful responding and avoidance of flawed responses at surface level, or detailed high-fidelity reports may certainly profit from cautious strategies that prevail under negative mood. However, whenever the criterion for successful learning depends on active organization and integration of complex stimulus material, as is typical for higher-order academic learning, a pronounced positive-mood advantage can be expected.

In a seminal study by Mandler and Pearlstone (1966), participants in a free group, who consistently used their own self-determined categories to sort 52 stimulus instances of various kinds, showed clearly superior recall compared to participants in a constrained group on whom the categories of the free group were imposed. Self-determined category coding led to fewer errors, less time required per trial, and more efficient learning than other-determined learning and retrieval processes (see also Bäuml & Kuhbandner, 2003; Rundus, 1973). Pertinent to this theoretical background, it has been shown that positive mood facilitates organization and clustering in memory (Bless et al., 1992; Fiedler & Stroehm, 1986; Lee & Sternthal, 1999). Moreover, embedding isolated pictures in self-generated picture stories has been shown to greatly increase the resulting recall performance (Fiedler, 1990).
Enduring memory not only depends on the assimilation of new information to existing schemas and knowledge structures but also on the strategic forgetting of old and obsolete stimuli that may interfere with new incoming information. An intriguing finding in this context is that retrieval-induced forgetting of lists of isolated items only works in positive but not in negative mood (Bäuml & Kuhbandner, 2007). Thus, the active suppression (inhibitory control) of unattended learning items, which serves to protect attended items from interference, is facilitated through assimilation in positive mood. This finding can be explained by the assumption that positive moods encourage relational processing that should increase interference from competing memory contents. Negative mood, in contrast, encourages item-specific processing, which in turn reduces interference and retrieval-induced forgetting of competing materials.

Perhaps, this convergent evidence for top-down organization and relational processing as the crucial principle of memory (Mandler, 2011) should not be overstated, and the importance of careful item-specific bottom-up processing should not be underestimated. Nevertheless, outside the realm of episodic memory for arbitrary lists, in meaningful problem environments, the available evidence emphasizes the crucial role of organization and generative coding. For example, many ordinary mathematics tasks cannot be solved by merely memorizing associations. Relying on analogies and inferences derived from organized knowledge is inevitable to come to a solution. With this insight in mind, it is not surprising that math performance was also found to profit from positive mood (Bryan & Bryan, 1991).

MOOD-CONGRUENCY EFFECTS

One particularly prominent consequence of an assimilative processing style is mood congruency (Bower, 1981; Clore, Schwarz, & Conway, 1994; Forgas, 1995)—that is, the processing advantage of mood-congruent information. In positive mood, pleasant information is more readily attended to, perceived, encoded, learned, retrieved, and inferred, and positive mood gives rise to more positive judgments and optimistic decisions. In contrast, negative mood produces a relative processing advantage for negative stimulus information. Although mood congruency is often treated as a separate phenomenon, it is but a special case of assimilation. Congruency effects are therefore asymmetrically stronger for positive than negative mood. Mood-congruent memory or judgment means that the affective value of target stimuli is assimilated to the individual's internal affective state.

To illustrate, in the aforementioned research by Fiedler et al. (2003) on mood and the generation effects, self-generated words were not only recalled better, particularly when people were in good mood, rather, this generation advantage came along with a marked bias to recall more mood-congruent words. This congruency advantage was almost totally confined to the recall of self-generated words by participants in the positive-mood condition. As summarized in Forgas’s (1995) affect-infusion model, most evidence for mood-congruency effects is peculiar to assimilative tasks that leave many degrees of freedom for constructive processing (Forgas, 1992, 1995).

In educational settings, congruency effects are manifested in two consequential phenomena, self-efficacy judgments and achievement evaluations. Both phenomena are crucial for students’ achievement motivation and self-attributions, which in turn affect their future achievement. First, several studies have shown that positive mood enhances self-efficacy, conceived as the optimistic and confident appraisal that one can master
the task at hand if one mobilizes one's own talents and motivation (Kavanagh & Bower, 1985; Thelwell, Lane, & Weston, 2007). As a consequence, aspiration setting and self-confidence profit from this sort of mood-congruent self assessment.

Second, the enhanced confidence and optimistic attitude of learners in positive as opposed to negative affective states reflects their differential attribution styles. During elated states following the receipt of performance feedback, participants in a study conducted by Brown (1984) tended to attribute experienced success (induced by bogus feedback) to more stable causes than during negative states previously induced by failure feedback. In general, judgments of elated participants were biased in a self-enhancing direction following success, whereas manipulated performance outcomes had no effect on the causal attributions of participants who were temporarily induced to feel depressed.

**THE MOOD-CREATIVEITY RELATION**

Creativity affords another influential consequence of an assimilative processing style. Creativity can be characterized as a top-down process whereby the given input stimulus is transformed and enriched with activated internal knowledge structures (Fiedler, 2001b) and (analogical or heuristic) inference tools. Pertinent research shows that happy mood leads to more unusual associations (Isen, Johnson, Mertz, & Robinson, 1985), facilitates problem solving, including combining material in a new and unusual way (Ashby, Isen, & Turken, 1999; Isen et al., 1987), and more flexible categorizations (Isen & Daubmann, 1984). All these effects reflect mood influences on creativity, operationalized as the ability of a person to generate new, potentially useful and original ideas, insights, and inventions (Amabile, 1983). Meta-analytic evidence suggests that creativity is most enhanced by activating positive mood, fostering an approach motivation, as is the case in the example of happiness (Baas, De Dreu, & Nijstad, 2008).

However, positive mood does not always lead to a better performance on creative generation tasks. Feeling-as information approaches (e.g., Schwarz, 1990) assume that negative mood signals a problematic situation, and—in line with an accommodation strategy—advises individuals to invest more cognitive effort but also prevents them from taking risks or using novel alternatives. Positive mood, in contrast, suggests that a situation is safe and thus—in line with an assimilative strategy—encourages individuals to seek stimulation and incentives. Based on these theoretical assumptions, Friedman, Förster, and Denzler (2007) analyzed the performance in a creative generation task that was either framed as silly and fun or as serious and important, thus making the task motivationally compatible with positive or negative mood, respectively. They found an increased effort for tasks fitting the subjects’ affective state. Thus, subjects in negative mood showed an enhanced effort for tasks framed as important but in positive mood for tasks framed as fun. All these studies suggest that every student can be regarded as potentially creative (Isen et al., 1987) and, depending on auspicious situational conditions and appropriate task framing, students may enhance their performance on creative problems considerably.

**PERSISTENCE, EFFORT EXPENDITURE, GOALS PURSUIT**

Related to the aforementioned study by Friedman et al. (2007), Martin, Ward, Achee, and Wyer (1993) demonstrated that the influence of affect on peoples’ persistence in regard to working on a task depended on the framing of the task. More precisely, when
people were instructed to continue working on a task until they no longer enjoyed it, they showed higher persistence in a good in comparison to a bad mood. When they were instructed to continue working until they felt like having gained enough information, however, the opposite mood effect emerged. Good mood led them to stop earlier than bad mood. In both cases, these findings are in line with the notion that mood is used as information about whether or not to continue working on a task, although with different implications derived from positive and negative affective cues, depending on the framing of the question asked.

Conversely, how much effort is spent on a task can also influence the rate and strength of resulting mood effects. According to the affect infusion model (Forgas, 1995), mood effects on judgments vary depending on the dominant processing strategy in a given task situation. This model distinguishes between four processing strategies that are characterized by (a) variation in high versus low motivation and effort expended in a task and (b) variation in whether a task calls for closed or open-ended and constructive information search. The resulting four strategies are (1) direct access (low effort, closed information search), (2) motivated processing (high effort, closed information search), (3) heuristic processing (low effort, open-ended information search), and (4) constructive processing (high effort, open-ended information search). What strategy is chosen depends on the familiarity of the task, features of the person making a judgment, and situational features. There is ample empirical support for stronger affective influences when the task calls for open-ended information search, regardless of effort expenditure. That is, mood influences are strongest for heuristic and constructive processing strategies as compared to motivated processing and direct access (Fiedler, 2001b; Forgas, 1995).

Persistence and effort expenditure, two crucial preconditions of academic performance, are related to the students’ goals. Performance increases for harder rather than easier goals and for challenging goals with a clearly specified set-up, in comparison to unspecific goals (Locke, Shaw, Saari, & Latham, 1981). Classroom related affective states are linked to the students’ goal structure and their adoption of specific achievement goal orientations. The adoption of a mastery goal—that is, a goal to learn and understand (Dweck & Legget, 1988)—is associated with an increase in positive emotions like enjoyment of learning as well as a decrease in negative emotions like boredom (Pekrun, Elliot, & Maier, 2006). Adopting a performance approach goal—that is, the goal to be better than others (Elliot, 1999)—was found to be associated with the positive emotion pride. In contrast, the adoption of a performance avoidance goal—that is, a goal not to appear incompetent, stupid, or uninformed in comparison to others—was consistently related to the negative emotion test anxiety (Middleton & Midgley, 1997; Skaalvik, 1997) and was found to be associated with specific negative emotions like anxiety and hopelessness (Pekrun et al., 2006). However, the relation between goals and affect might not be a unidirectional but a reciprocal one as proposed in Linnenbrink and Pintrich’s (2002) bidirectional model. Thus, affective states might also influence which goals a student adopts. In line with this assumption is the finding that students who experience positive affect are subsequently more likely to perceive their classroom as being focused on the goal to learn and understand (Kaplan & Midgley, 1999).

One specific cognitive activity that can interfere with academic achievement is engaging in unrealistically positive fantasies. Fantasies are freely occurring visualized images and thoughts concerning one’s own future life and achievement, largely detached from actual past experiences (Klinger, 1990; Oettingen & Mayer, 2002). Oettingen and Mayer
(2002) argue that these positive fantasies allow people to experience a pleasant future at the moment while masking the necessary effort one has to invest to actually realize the idealized future. Such fantasies are correlated with lower effort expenditure and academic achievement (Kappes, Oettingen, & Mayer, 2012; Oettingen & Mayer, 2002). However, Langens and Schmalt (2002) argue that especially for people who have a high fear of failure, engaging in positive fantasies might not lead to positive affect due to an anticipatory experience of a pleasant future. These authors assume that people high in fear of failure experience negative emotions like depression when they engage in positive fantasies. Due to low success expectancies, positive fantasies might make the potential absence of the anticipated outcome in the future particularly clear. In line with these assumptions, the authors demonstrated higher feelings of depression after engaging in positive fantasies about attaining agentic personal goals and, possibly motivated by an effort to repair this negative mood repair, disengagement from this goal.

**Distinct Appraisal Functions and Consequences of Specific Emotions**

In educational settings, students experience a variety of emotions. Anxiety is one of the most commonly experienced emotions by students. However, positive emotions are experienced about as often as negative ones (Pekrun, Goetz, Titz, & Perry, 2002). Going beyond the broad distinction of positive and negative mood, it is worth considering various specific emotions, such as boredom, anxiety, and enjoyment of learning, and their association with specific situational appraisals as well as their effects on cognitive processing and academic outcomes. We choose these emotions because they represent distinct emotions representing positive (enjoyment) and negative (boredom, anxiety) as well as activating (enjoyment, anxiety) and deactivating (boredom) emotions important in the educational context (Goetz, Frenzel, Pekrun, & Hall, 2006). Appraisal theories generally assume a connection between the appraisal of an environment and the elicited emotion. As a result, the experienced emotion is shaped by the cognitive interpretation of the situation (Smith & Ellsworth, 1885).

**Emotion Appraisal in Educational Settings**

Smith and Ellsworth (1987), for example, illustrated that different emotions elicited before and after taking a college midterm exam were associated with distinct appraisals of that situation. For example, the experience of anger before or after the exam was predicted by an appraisal of the situation as unfair, the experience of fear by an appraisal of unpleasantness, and the experience of happiness, on the contrary, by an appraisal of the situation as pleasant. Hope and challenge experiences before or after the exam were predicted by an appraisal of anticipated effort in regard to the test situation, and the experience of apathy by an appraisal of agency other than oneself.

In educational contexts, an appraisal of the learning and achievement related activities are of primary relevance to determine what specific subsequent achievement emotion—that is, an emotion that is linked to achievement activities or outcomes (Pekrun, 2006)—is experienced. More precisely, Pekrun (2006) assumes in his control-value theory of achievement emotions that the perceived control of learning and the subsequent outcomes as well as the subjective value of the achievement activities and outcomes are of particular importance in this context. For example, enjoyment of learning is characterized by a subjective feeling of control over and positively valuing learning
activities and outcomes, anxiety in regard to a test is characterized by rather low subjective control paired with a high subjective value of the test’s outcome, and boredom is characterized by a either high or low subjective control paired with a lack of subjective value (Pekrun, Goetz, Daniels, Stupnisky, & Perry, 2010). Since the specific emotions experienced in achievement contexts are critically influenced by the specific appraisal pattern in these situations, it follows that the students’ emotional experiences are domain specific (Pekrun, 2006). Goetz et al. (2006) tested this assumption for the emotional experience in regard to the domains mathematics, Latin, German, and English of students in the seventh to tenth grade. For the examined emotions academic enjoyment, anxiety, and boredom, the results indicated that a domain specific organization of emotions with academic enjoyment showed the highest domain specific organization. The relations between different emotions in the same domain were related stronger than experiences of a specific emotion across domains. These authors concluded that students might therefore especially benefit from domain specific counseling and interventions in regard to their emotional experiences in school.

Boredom

Boredom is a specific emotion that is abundantly experienced by students in educational settings but not yet thoroughly researched in this context. It is characterized by lack of stimulation in combination with low arousal (Harris, 2000; Pekrun et al., 2010). In line with the control-value theory of achievement emotions (Pekrun, 2006), Pekrun et al. (2010) demonstrated that the feeling of boredom was most of the time associated with a perception of a lack of control over and lack of value of achievement activities. Especially important in educational settings, these authors also showed that boredom predicted lower academic performance. Cognitive consequences of experiencing boredom are attention impairments. Students have problems concentrating when they are bored and are more prone to being distracted by task irrelevant things. As a negative emotion, boredom is negatively associated with assimilative task handling strategies like elaboration. However, boredom most likely does not induce the use of accommodative, repetitive learning strategies, but these rehearse strategies might induce boredom. In accordance with the previously discussed adaptive function of emotions, boredom leads to lower intrinsic motivation, effort, and, in the end, a tendency to escape the boring situation. Trying to provide individual students more with tasks that match their abilities or guide them to self-regulate their study activities to make them feel more self-controlled might help to reduce their boredom and as a consequence to avoid the negative motivational and performance-related consequences associated with boredom (Pekrun et al, 2010).

Test Anxiety

Students’ anxiety—in particular, test anxiety—is one of the most well researched achievement emotions, and it has been addressed in more than 1,000 studies (Pekrun et al., 2010). In line with the control-value theory, classroom variables that are associated with an appraisal of control- and value-related aspects of achievement outcomes and activities (for example, punishment after failure, high achievement expectations, and a competitive classroom) are correlated with students test anxiety (Pekrun et al., 2002). The construct of test anxiety has been differentiated in past research, and the components worrying about failure and negative consequences, automatic emotional reactions to test
situations, interfering and distracting cognitions, and low confidence are distinguished. These components are differently associated with different coping styles. For female students, for example, worrying is associated with preparing more and low avoidance coping, and for both male and female students, the relationship is revere for the interference component (Stöber, 2004). A cognitive consequence of test anxiety is a reduction of the working memory capacity, which, as a result, impairs the performance on academic tasks. In general, test anxiety is associated with lower academic performance. In regard to motivational variables, test anxiety is negatively correlated with intrinsic and overall extrinsic motivation. However, test anxiety is positively associated with making an effort to avoid failure (extrinsic avoidance motivation; Pekrun et al., 2002). Meta-analytical evidence suggests that higher scores in test anxiety are associated with an adoption of performance goals—in particular, performance avoidance goals (Huang, 2011).

**Enjoyment of Learning**

Enjoyment of learning is the pleasure students experience while performing learning activities (Ainley & Ainley, 2011). Students experience enjoyment in specific learning situations and habitually associate a certain level of this emotion with learning activities in general. While on average, the learning enjoyment is on a positive level, students experience a decrease in this emotion with increasing school years (Hagenauer & Hascher, 2011). In line with the control-value theory (Pekrun, 2006), students’ value of science predicted their enjoyment of learning in this school domain. Also, the students’ enjoyment was closely related to their interest in learning more about science topics (Ainley & Ainley, 2011). In regard to students’ motivation, the experience of enjoyment of learning is positively associated with their intrinsic and extrinsic motivation as well as their self-reports on academic effort. Not only is this positive emotion associated with beneficial motivational variables, but the experience of enjoyment of learning also predicts higher academic achievement (Pekrun et al., 2002). As a positive emotion, enjoyment is related to assimilative learning strategies, like elaboration, critical thinking, and metacognitive strategies (Pekrun et al., 2002). Similar to these findings, Goetz, Hall, Frenzel, & Pekrun (2006) showed that students’ use of learning strategies, like self-regulated learning, learning from mistakes, and trying to tackle academic tasks in a creative and flexible way were positively correlated with their enjoyment of learning.

**Regulation of Affective Behavior**

Granting that mood states and specific emotions both reflect and influence social and academic learning, the bidirectional relation between emotion and cognition constitutes a regulatory cycle, within which longitudinal developments can be understood. As already mentioned, the adaptive interplay of accommodative and assimilative strategies that characterizes different affective states is intrinsically self-regulated. Careful and thorough accommodation strategies (e.g., caution, minimization of mistakes) preclude the perpetuation of negative states and support the reestablishment of positive states. Conversely, carefree and jaunty assimilation strategies (e.g., overconfidence, impoliteness) entail the potential to prevent positive states from perpetuation and to return to more negative styles. Apparently, such a regulatory cycle has several desirable and adaptive consequences that should ideally support an individual’s motivation, learning potential, and well-being. The resulting variation in affect, cognition, and behavior should
be a remedy of habituation and saturation and provide individuals with valuable contrast experiences, affect-related wisdom, and emotional intelligence (Salovey & Grewal, 2005). Frequent shifts in adaptive strategies dealing with ever-changing environmental settings, learning tasks, and social situations might serve to foster the individual’s development and maturation.

Abnormal and pathological developments, such as depression or antisocial delinquency, seem to reflect anomalies in such a cyclic regulation process. Typical for a depressive loop, for instance, seems to be the inability to repair one’s depressed mood and to reestablish positive affective states, self-worth, and the optimism that characterizes assimilative tendencies.

MOOD REPAIR: SELF-REGULATION OF AFFECT

The experience of a specific affective state itself may trigger the motivation to regulate one’s own affective state. The mood repair hypothesis claims that people seek to maintain positive mood because of its hedonic value and to avoid negative moods experienced as aversive or unpleasant (Isen, 1984; Taylor, 1991). Thus, it is assumed that people deliberately try to improve their mood and that the experience of an unpleasant versus pleasant mood is the crucial cue that drives mood repair. However, as Erber and Erber (2001) have summarized, the empirical evidence suggests that effective mood repair depends both on motivation and appropriate skills. Both of these conditions are shaped by situational constraints. For example, a student’s experience of happiness, who wants to console a friend because of a bad grade, is constrained by this situation motivating the student to regulate his/her feelings of happiness. Erber and Erber (2001) assume in their social-constraints model that goal attainment affords the most important principle for peoples’ self-controlled mood regulation. The experience of a certain mood, even if it is a negative one, is not the main motivating reason for whether or not people engage in mood repair, according to the findings summarized by these authors. Without situational constraints making regulation of the own mood necessary, people do not show mood regulation and maintain their current positive or negative mood. However, if being in a happy mood, for example, distracts students from focusing on a learning task because of intruding thoughts regarding pleasant weekend plans, then they may want to regulate their happy mood state and try to achieve a more neutral mood state that is more appropriate to their learning and achievement goals.

PRIMING, SIGNALING, AND MINIMAL AFFECTIVE CUES

Regulation is not contingent on intensive or hedonically important affective states. Subtle and even subliminal affective cues can signal environmental changes, threats, or chances calling for adaptive reactions and appropriate strategies. Numerous studies have demonstrated that emotional treatments need not be incisive or intensive to exert systematic effects. Finding a dime in a Xerox machine (Isen & Levin, 1972), facial muscle activity that simulates a smile (Stepper & Strack, 1993), or the subtle feeling of fluency associated with a mental task (Schwarz, 1990) are examples of subtle affective cues that suffice to induce mood-congruency effects or mood-specific cognitive strategies. In contrast, experiencing a feeling of difficulty or simulating a frowning face is sufficient to trigger reactions associated with aversive situations.
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Affective Priming

One pertinent paradigm here is affective priming (Fazio, 2001). The time required to categorize a target stimulus as either positive or negative is reduced when the valence of the preceding prime matches the valence of a subsequent target to be evaluated. This congruity effect in affective priming is remarkably similar to the congruency effects obtained in free recall and social judgments. Like the latter class of findings, congruity in affective priming is asymmetrically stronger for positive rather than negative primes, and affective primes need not be intensive or salient. If anything, affective priming (like semantic priming) was generally found to decrease or even disappear when too strong and blatant primes are attended to and consciously experienced as distinct entities, clearly separate from the target (Fiedler, Bluemke, & Unkelbach, 2011). This phenomenon is analogous to the disappearance of mood congruency when mood can be attributed to external origins (Schwarz & Clore, 1983).

One way to understand the analogy between mood congruency and priming congruity is to assume that affective primes constitute minimal mood treatments that have been associated with stronger mood treatments in the individual's learning history, much like conditional stimuli have been associated with unconditional stimuli. This assumption offers a simple account of the powerful impact of subtle affective cues on the regulation of behavior.

Fluency

In the realm of learning and education, for instance, an influential regulatory cue is fluency. The feeling of fluency, as, for example, induced by easy-to-solve puzzles, high color contrast of written text, or simple mental rotations, is not only experienced as hedonically pleasant but also induces a feeling of confidence, truth, and an illusion of learning (Koriat & Bjork, 2005; Unkelbach, 2006; Winkielman, Schwarz, Fazendeiro, & Reber, 2003).

In contrast, the feeling of disfluency or unease, as induced by hard to solve puzzles, insufficient color contrast, or difficult mental rotations, is typically experienced as unpleasant and serves to reduce self-confidence and subjective truth. An apparent adaptive function of the fluency cue is to discriminate easy and unproblematic situations from difficult and problematic ones. Whereas high fluency encourages organisms to continue performing ongoing actions, low fluency signals the need to overcome some obstacle and to change one's current strategy.

Disfluency and Cognitive Reflection

An intriguing ironic consequence of this regulatory mechanism is that experienced fluency can undermine effort expenditure and persistence motivation whenever the fluency cue creates an unrealistic illusion of learning and understanding (Koriat & Bjork, 2005). In contrast, the hedonically unpleasant feeling of disfluency may trigger extra efforts and deliberate attempts to try out new strategies and problem solutions. Such benevolent consequences of disfluency have been observed recently in several experimental studies. Alter, Oppenheimer, Epley, and Eyre (2007) manipulated fluency by presenting Frederick's (2005) cognitive reflection test (CRT) printed either in easy-to-read black Myriad Web 12-point font or in a difficult-to-read 10% gray italicized Myriad Web 10-point font.
Participants in the former (fluent) condition frequently chose the intuitively most plausible but wrong response options. Participants in the latter (disfluent) condition in contrast engaged in second thoughts and were thus more likely to find out the correct solutions.

In another experiment, fluency was manipulated by proprioceptive feedback from facial muscles in that participants were instructed either to puff their cheeks (fluent condition) or to furrow their brows (disfluent condition). The resulting feeling of disfluency helped participants to overcome the so-called base-rate neglect (i.e., the failure to take the base rates into account when judging the profession of a target person described in a vignette). According to Alter et al. (2007), feelings of task difficulty or disfluency reduce the danger of premature, heuristic judgments, unreflected reliance on misleading peripheral cues, and instead facilitate deeper and more analytic reasoning.

Distrust

In a related vein, Schul, Mayo, and Burnstein (2008) manipulated distrust in several ways, such as by presenting faces that had been pretested to convey different degrees of suspiciousness. Similar to disfluency, distrust led participants to avoid routine strategies and to try out new and unusual strategies. For instance, people exposed to distrust-inducing faces solved trickier matchstick problems than people exposed to trustworthy, safety-inducing faces. Thus, distrust was shown to benefit performance on tasks that call for nonroutine, innovative strategies.

Achievement Priming

In addition to these indirect influences of affective primes on learning and achievement goals, other studies have revealed direct influences of achievement-related cues. For example, in a series of studies by Hart and Albarracin (2009), achievement-denoting word primes were successfully used to increase self-reported task performance and task resumption following an interruption. However, achievement priming was only effective in participants with chronic high achievement motivation. The same primes inhibited a goal to achieve and instead activated fun goals in people with low achievement motivation.

CONCLUDING REMARKS

To summarize, with regard to both domains of education, formal learning and socialization, our theory-driven review of the cognition–emotion link leads to the same general conclusions.

Recapitulation of Basic Insights

First, it is useful to distinguish between the two complementary adaptive functions of accommodation and assimilation. Negative affective states increase the individual’s accommodative attempts to deal with environmental constraints, fostering careful stimulus-driven processing in the learning domain and norm-conforming strategies in the social domain. These strategies, in turn, entail the potential for mood repair and variation in affect and associated strategies. Positive affective states will then give the individual the backing-up for assimilative strategies, characterized by knowledge-driven...
creative and exploratory behavior in the learning domain and independence of external norms in the social domain. Again, the consequences of these innovative and uncertain strategies entail the potential for mood impairment. Over time, as a consequence of this dialectic interplay of both adaptive functions, the individual has to deal with contrasting affective experiences and to acquire a rich repertoire of strategies, which in turn facilitates successful education and development in the long run. Malfunctioning regulation (inability to down-regulate assimilative strategies; failure of mood repair) can be the source of pathological developments.

Second, in regard to another consequence of this cyclic regulation process, the available evidence shows that any simplified, one-sided answer to the question of whether achievement and motivation profit from positive or negative mood is inappropriate. As a general rule, all things such as motivation or working memory capacity being equal, negative mood enhances performance on accommodative tasks that call for detailed stimulus assessment in accordance with externally provided rules. Positive mood, in contrast, benefits performance on assimilative tasks that depend on exploration and the creative ability to go beyond the given stimulus input. Although learning tasks and developmental tasks of both kinds are important for the individual’s growth and maturation, it seems justified to conclude that higher-order intellectual functions of memory organization as well as self-determined behavior and emancipation are basically assimilative functions.

Third, it is important to note that affective states need not be enduring, intensive, or biologically significant to exert a systematic influence on achievement, motivation, and behavior regulation. Subtle affective cues have often been shown to be sufficient for inducing assimilation and accommodation effects, including mood congruency biases, as evident from numerous experiments using affective priming and symbolic stimuli associated with appetitive and aversive settings. Of particular relevance to education here is the role of fluency for learning and motivation. The feeling of flow or subjective ease, which signals proper functioning and lack of obstacles, has been shown to create an illusion of learning that can undermine motivation and effort expenditure. In contrast, the feeling of difficulty and impairment is actually a concomitant of good learning and effective learning transfer (Bjork, 1994).

Schools play a major role for the development of the ability to regulate emotions and to take them into account for information processing (McLaughlin, 2008). As already pointed out in the introduction, in the first two decades of most people’s lives, there are not many similarly important sources of affective experience comparable to educational settings. While interacting with students and teachers, who might in some cases even serve as most important role models next to role models from families, children learn how to relate emotionally to others and to themselves (McLaughlin, 2008). Within such a socially challenging and emotionally rich school environment, calling for contrasting experiences with both adaptive functions of assimilation and accommodation, the psychological conditions should be met for effective learning, regulation, and personal growth.

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