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Control-value theory: Using achievement emotions to improve understanding of motivation, learning, and performance in medical education: AMEE Guide No. 64

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Abstract

In this AMEE Guide, we consider the emergent theoretical and empirical work on human emotion and how this work can inform the theory, research, and practice of medical education. In the Guide, we define emotion, in general, and achievement emotions, more specifically. We describe one of the leading contemporary theories of achievement emotions, *control-value theory* (Pekrun 2006), and we distinguish between different types of achievement emotions, their proximal antecedents, and their consequences for motivation, learning, and performance. Next, we review the empirical support for control-value theory from non-medical fields and suggest several important implications for educational practice. In this section, we highlight the importance of designing learning environments that foster a high degree of control and value for students. Finally, we end with a discussion of the need for more research on achievement emotions in medical education, and we propose several key research questions we believe will facilitate our understanding of achievement emotions and their impact on important educational outcomes.

Introduction: Emotions and learning

Emotions are ever-present in academic and clinical settings. Consider a second-year medical student preparing for a major exam. He probably hopes for success, may worry about failure, and likely feels relieved once the exam is over. These emotions – hope, worry, and relief – likely influence his motivation, the effort he puts forth, and even the study strategies he uses to help him understand the material. Similarly, think of a young intern/pre-registrar preparing to perform a new clinical activity. Depending on her goals, the nature of the activity, and the social support she receives within the clinical setting, she may enjoy preparing for the activity, feel bored because it is not really interesting to her, or experience frustration because the new activity simply represents one more thing to do in her never-ending list of things to do. Once again, these emotions – enjoyment, boredom, and frustration – almost certainly affect her preparation, her motivation to persist in the face of difficulties, and the motivational strategies she employs to stay on task and curb non-adaptive behaviors like procrastination.

Historically, these types of emotions have received little attention from education researchers, in general, and medical education researchers, more specifically. Two notable exceptions in the educational psychology literature are Weiner's (1985) work on attribution theory and the abundance of test-anxiety research conducted over the last 30 years (for a review, see Zeidner 1998). Notwithstanding these exceptions, most classic models of cognition, such as traditional information-processing theories (Miller 1956), do not consider "non-cognitive" constructs like emotion and motivation to be theoretically interesting or even important (Dweck et al. 2004). Indeed, many psychologists previously conceptualized human thinking – and more specifically, academic thinking – as primarily a cognitive activity, relatively free from emotion and motivation (Brown et al. 1983). The implication of these "cognition-only" models of human thinking is, *an account of thinking as fully disembodied, objective, mechanical, rational, and cold* (Dai & Sternberg 2004, p. 5). Described by some as *cold-cognition* models (Pintrich et al. 1993; Pintrich 2003), these theoretical perspectives do not account for individuals who seem to have the requisite knowledge and skills but fail to activate these knowledge and skills when necessary (Bereiter & Scardamalia 1985).

In response to the limitations of *cold-cognition* models, scholars across diverse fields of inquiry have called for more integrative approaches to human thinking and learning (Dai & Sternberg 2004; Linnenbrink & Pintrich 2004; Picard et al. 2004; Artino & Durning 2011). Such approaches emphasize *affect* and put emotion and motivation on a similar footing as

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Practice points

- Emotion can be defined as an acute, intense, and typically brief psycho-physiological change that results from a response to a meaningful situation.
- *Achievement emotions* are those emotions tied directly to achievement activities or outcomes.
- Achievement emotions are ever-present in academic and clinical settings; however, these types of emotions have received little attention from medical education researchers.
- Achievement emotions influence cognitive resources, motivation, use of cognitive and metacognitive learning strategies, and overall learning and performance. In general, positive or pleasant emotions are thought to exert adaptive effects on learning and performance; whereas negative or unpleasant emotions tend to exert non-adaptive effects.
- *Control-value theory* is a comprehensive, integrative approach to understanding emotions in education. The theory posits that achievement emotions are determined, in part, by an individual's cognitive appraisal of *control* and *value*.
- Instructors can influence students' achievement emotions—and subsequent motivation, learning, and performance—by creating learning environments that are sensitive to (and, in some cases, explicitly address) students' control and value appraisals.

cognitive constructs like attention and memory. These integrative perspectives highlight the whole person in real situations and put thinking and learning back in the context of humans adapting to and interacting with their environments (Mayer 1996). Indeed, in just the last 10 years, *emotion* has taken center stage in much of the contemporary educational psychology literature, no longer relegated to secondary status behind traditionally studied cognitive constructs (Dai & Sternberg 2004; Schutz & Pekrun 2007).

In this AMEE Guide, we consider the emergent theoretical and empirical work on emotion and reflect on how this work might inform the theory, research, and practice of medical education. We believe such an exploration is timely given efforts worldwide to transform medical education from a traditional time and process-based model to an increasingly outcomes-based model (Harden et al. 1999; Carraccio et al. 2002). Outcomes-based approaches, better known as competency-based medical education (CBME), place greater emphasis on individual learner trajectories, self-directed learning, assessment and feedback, and reflective practice (Carraccio et al. 2002; Frank et al. 2010; Holmboe et al. 2010). In this context, we believe an understanding of emotion's role in learning will be increasingly important.

To begin, we define emotion and, more specifically, we characterize emotions that are tied directly to academic and/or achievement settings, often referred to as "achievement emotions." Next, we detail one of the leading contemporary theories of achievement emotions, *control-value theory* (Pekrun 2006), and distinguish between different types of achievement emotions, their proximal antecedents, and their consequences for motivation, learning, and performance. We then review the empirical support for control-value theory from fields outside of medicine and suggest implications for education, in general, and medical education, in particular. Finally, we end with a discussion of the need for more research on achievement emotions in medical education, and we propose a research agenda that we believe will facilitate better understanding of how achievement emotions might influence motivation, learning, and performance in medical training.

Theoretical foundations

What is emotion?

Before discussing achievement emotions, it is helpful to first define emotion. Unfortunately, there is no clear consensus among psychologists as to the one best definition of emotion. Instead, research and theory on emotion has been characterized by a fair amount of definitional confusion (Buck 1990). This confusion stems, in part, from the notion that emotions have been studied from many different disciplines including psychology, neuroscience, sociology, and philosophy, to name just a few (Gross 1998). Nonetheless, in terms of organization and association with other constructs, emotion is usually considered a subset of the more general term *affect*. Affect has been further subdivided into two categories: affective *traits* and affective *states*. Within this general taxonomy, *moods* and *emotions* are usually considered two distinct types of affective states (Rosenberg 1998), with the distinction between moods and emotions based primarily on their intensity and duration. That is, moods tend to be longer, more diffuse, and without a particular referent (e.g., feeling depressed); whereas emotions tend to be shorter, more intense, and in response to a particular referent (e.g., being anxious about an upcoming exam; see Rosenberg 1998; Forgas 2000).

Using this basic framework, emotion can be defined as *an acute, intense, and typically brief psycho-physiological change that results from a response to a meaningful situation in an individual's environment* (Artino 2010, p. 1236). Emotions are experienced from an individual's point of view, and most psychologists agree they involve a set of related psychological processes with *affective, cognitive, physiological, motivational, and expressive components* (Pekrun & Stephens 2010, p. 239). So, for instance, a medical student's anxiety about a challenging clinical task could be composed of nervous feelings (affective), concern about not performing well (cognitive), decreased parasympathetic and increased sympathetic tone (physiological), a desire to escape the stressful situation (motivational), and troubled facial expressions (expressive).

What are achievement emotions?

Pekrun (2006) has defined achievement emotions as *emotions tied directly to achievement activities or achievement outcomes* (p. 317). Achievement activities include, for example, working independently to understand a patient's problem,

listening to a lecture, or participating in bedside rounds. Activity-related achievement emotions, then, would include those emotions experienced during these activities; for example, the enjoyment of engaging in an interesting patient problem, boredom experienced during a dull lecture, or anger experienced when a preceptor imposes unreasonable ward and team presentation requirements. On the other hand, achievement outcomes include activity successes or failures, such as performing well on an exam or receiving a less-than-stellar evaluation from an instructor following a clinical skills assessment. Therefore, outcome-related achievement emotions would include those emotions experienced in response to these outcomes; for example, the enjoyment of receiving a good exam grade or the feeling of hopelessness after getting yet another unsatisfactory clinical performance rating.

Traditionally, outcome-related achievement emotions have received greater attention in the educational psychology literature (Weiner 1985; Zeidner 1998). However, the historical emphasis on outcome-related emotions is now being supplanted by contemporary educational psychology work, which places *equal* importance on activity-related achievement emotions and their influence on motivation, learning, and performance outcomes (Pekrun & Stephens 2010).

Control-value theory: Definition and dimensions

The most relevant and well-studied work on achievement emotions has been carried out by Reinhard Pekrun at the University of Munich and his colleagues in Europe, the United States, and Canada (Pekrun et al. 2002; Goetz et al. 2010; Pekrun & Stephens 2010; Pekrun et al. 2010). Using what is generally considered a social-cognitive framework, Pekrun (2000, 2006) has developed *control-value theory*, a comprehensive, integrative approach to understanding emotions in education. Control-value theory groups achievement emotions by their *valence* (positive vs. negative, or pleasant vs. unpleasant); degree of *activation* (activating vs. deactivating); and *object focus*, as described above (activity vs. outcome; Pekrun et al. 2007). Using these three dimensions – valence, activation, and object focus – control-value theory proposes a three-dimensional taxonomy of achievement emotions (valence × activation × object; Table 1). For instance, the boredom experienced during a dull lecture would be considered a *negative*, *deactivating*, *activity-related* achievement emotion; whereas the pride associated with arriving at a correct diagnosis with a challenging patient presentation would be considered a *positive*, *activating*, *outcome-related* achievement emotion. The performance consequences of these diverse emotions are discussed in greater detail later in this AMEE Guide.

In the following sections, the basic components, assumptions, and correlates of control-value theory will be reviewed in an effort to provide the reader with a framework for considering emotions in medical education contexts. A more detailed discussion, however, is beyond the scope of this AMEE Guide. The interested reader is encouraged to consult several other comprehensive articles and books chapters for more detailed treatments of the theory (e.g., Pekrun et al. 2002, 2007; Pekrun 2006; Pekrun & Stephens 2010).

Table 1. A three-dimensional taxonomy of achievement emotions (adapted from Pekrun & Stephens 2010).

Object focus	Positive (or pleasant)		Negative (or unpleasant)	
	Activating	Deactivating	Activating	Deactivating
Activity	Enjoyment	Relaxation	Anxiety Anger Frustration	Boredom
Outcome	Hope Joy Pride Gratitude	Relief Contentment	Anxiety Anger Shame	Hopelessness Sadness Disappointment

Control-value theory: Structure and assumptions

Cognitive appraisals. Pekrun's (2000, 2006) control-value theory posits that achievement emotions are proximally determined by an individual's cognitive appraisal of *control and value*. Control appraisals relate to the perceived controllability of achievement activities and their outcomes. These appraisals are often indicated by expectations and competence perceptions, such as self-efficacy (i.e., task-specific self-confidence) and self-concepts of ability, respectively. Value appraisals pertain to the subjective value or importance of these activities and outcomes, and can be intrinsic (e.g., an innate interest in math) or extrinsic (e.g., valuing an activity because it is likely to bring some external reward). These hypothesized linkages are represented in Figure 1 by an arrow connecting cognitive appraisals to achievement emotions. Importantly, control-value theory does not assume that these cognitive appraisals are always made consciously. Indeed, recurring activities and outcomes can induce emotions that largely become automatic over time (Pekrun & Stephens 2010). That is, repeated exposure to a given activity or outcome can lead to emotions that no longer require conscious cognitive appraisal. For example, when a teacher says "who's ready to take a quiz," many students will automatically begin to feel anxious about the prospects of being assessed, with little to no conscious cognitive effort required.

Environmental antecedents. Whereas cognitive appraisals are thought to determine various achievement emotions, more distal factors are assumed to influence achievement emotions primarily through their affect on control and value appraisals (see the list of environmental antecedents listed in Figure 1). In academic settings, examples of such distal factors could include the characteristics of the task being completed, the cognitive demands of the task, the amount of cognitive and emotional support provided by the instructor, and the overall learning climate. Further, the broader social and cultural context within the school, clinic, or content area may also influence cognitive appraisals which, in turn, can modify downstream achievement emotions.

Although the arrows in Figure 1 suggest that cognitive appraisals cause achievement emotions, in keeping with control-value theory, the relationships between cognitive appraisals and achievement emotions are thought to be

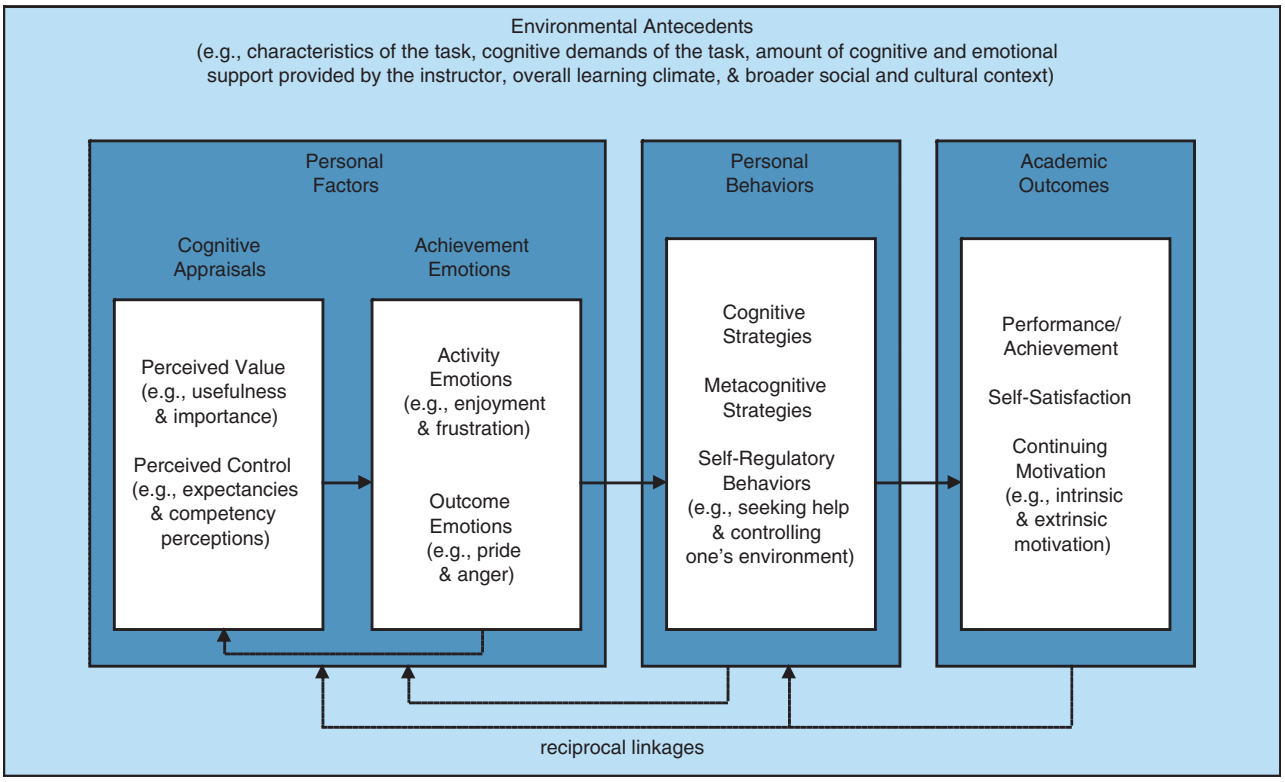

Figure 1. A control-value theory of achievement emotions (adapted from Pekrun 2006).

bidirectional (see the arrows labeled "reciprocal linkages" in Figure 1). That is, *control and value appraisals are posited to be antecedents of emotions, but emotions can reciprocally affect these appraisals* (Pekrun 2006, p. 327). For example, not only does a student's academic self-efficacy (which would be considered a cognitive appraisal in Figure 1) impact his achievement emotions, but negative feelings, such as test anxiety, can also influence his later self-efficacy beliefs. Thus, information conveyed by emotions is cognitively assessed by an individual and can positively (or negatively) influence self-efficacy beliefs, depending on the valence of the emotion, level of arousal, and the individual's cognitive appraisal (Bandura 1997).

Performance consequences. Control-value theory can guide predictions about how achievement emotions affect motivation, learning, and performance outcomes. Specifically, the theory predicts that achievement emotions *influence cognitive resources, motivation, use of strategies, and self-regulation vs. external regulation of learning* (Pekrun et al. 2007, p. 16). Further, the effects that emotions have on achievement are thought to be mediated by these cognitive, motivational, and behavioral processes (Figure 1). Finally, learning and performance outcomes are assumed to feed back into the system, acting on students' emotions, as well as influencing various facets of their learning environment and their cognitive appraisals of that environment. Thus, it can be said that environmental antecedents (e.g., characteristics of the task), cognitive appraisals, emotions, and their consequences are all linked by reciprocal causation across time (Figure 1; Pekrun et al. 2007). This assumption of reciprocity has important implications for emotion regulation and for educational interventions designed to foster healthy learning environments (see the section on instructional implications found later in this AMEE Guide).

There are, of course, differential effects of positive versus negative emotions. Positive emotions are generally hypothesized to facilitate the use of flexible, deep processing strategies such as elaboration (i.e., actively linking new information to previously learned content), organization, and metacognitive self-regulation (i.e., planning, goal setting, comprehension monitoring, and performance regulation). On the other hand, negative emotions are presumed to result in reduced attention and the use of more rigid, superficial processing strategies, like simple repetition and rehearsal (Pekrun 2006). Thus, in a general sense, positive or pleasant emotions are thought to exert positive or "adaptive" effects and negative or unpleasant emotions are thought to exert negative or "non-adaptive" effects.

However, to truly understand how positive and negative emotions might affect outcomes, one must also consider the *activation* dimension described above. With this dimension in mind, it is clear that positive achievement emotions will not always exert positive effects on motivation, learning, and performance. Likewise, negative achievement emotions will not always produce negative effects (Pekrun 2006). For example, a positive deactivating emotion, such as relief, could result in ambivalence, which, in turn, could have a detrimental effect on future learning and performance (Pekrun 2006). In fact, experimental mood research suggests that positive mood can often undermine effortful action and foster superficial cognitive processing (Aspinwall 1998). In some

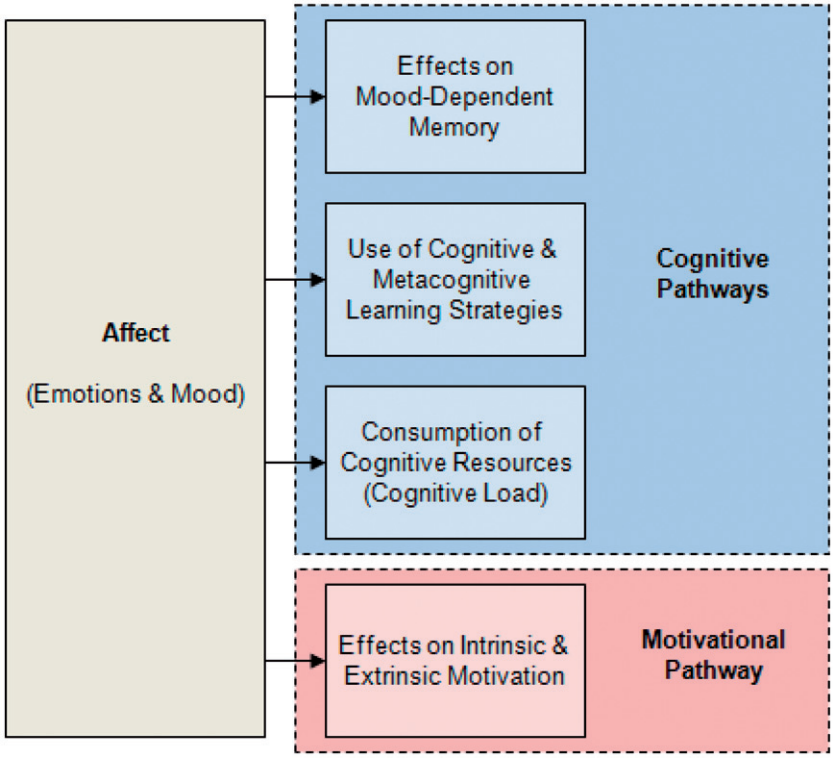

Figure 2. Four primary routes through which affect (emotions and mood) might influence various performance outcomes.

ways the "feel good" nature of positive affect can sometimes encourage us to become *lazy thinkers who are oblivious to potentially useful negative information* (Aspinwall 1998, p. 7). On the other hand, a negative activating emotion, such as anxiety, could exert a positive motivational effect on a highly confident student by, for example, prompting her to begin preparing for an upcoming exam that she has been avoiding. And so, to truly understand the consequences of various achievement emotions, we must first accept the notion that not all positive and negative emotions are created equal. To be sure, the effects that achievement emotions have on motivation, learning, and performance can be quite complex, resulting from a dynamic interaction between affect and cognition (Linnenbrink & Pintrich 2004; Pekrun 2006).

Measuring achievement emotions

In the empirical work of Pekrun and colleagues, achievement emotions are typically measured using a self-report survey called the Achievement Emotions Questionnaire (AEQ; Pekrun et al. 2005). The AEQ is a multidimensional instrument designed to assess college students' achievement emotions using a series of scales, with each scale composed of multiple survey items. The AEQ was developed using both quantitative and qualitative research methods; these methods have been described in detail elsewhere (Pekrun et al. 2002). The instrument assesses nine discrete emotions: four positive emotions (enjoyment, hope, pride, and relief), and five negative emotions (anger, anxiety, hopelessness, shame, and boredom). There are three sections to the AEQ, each containing class-related, learning-related, and test-related emotion scales. The class-related emotion scales include 80 items, the learning-related emotion scales consist of 75 items, and the test-related emotion scales include 77 items. Shorter versions of the AEQ scales are also available.

Sample AEQ items include: *I get excited about going to class* (class-related enjoyment), *Thinking about the poor quality of the course makes me angry* (class-related anger), *I have an optimistic view toward studying* (learning-related hope), *I worry whether I have properly understood the material* (learning-related anxiety), *I am proud of myself*' (test-related pride), and *I have lost all hope that I have the ability to do well on the exam* (test-related hopelessness). All items utilize a five-point, Likert-type response scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

The AEQ has been tested in a variety of educational contexts, cultures, and languages, and internal reliabilities are consistently high, ranging from 0.84 to 0.94 (Pekrun et al. 2002). Considerable validity evidence has also been collected, with the AEQ showing strong evidence of construct validity. For more detailed reliability and validity information, the interested reader is encouraged to consult the AEQ User's Manual (Pekrun et al. 2005).

Evidence for control-value theory in educational contexts

The links between emotion and subsequent learning and performance are complex. However, psychologists generally agree that there are likely four primary routes through which affect (emotions and mood) might influence various performance outcomes (Figure 2; Pekrun & Stephens 2010). As Schunk et al. (2008) describe, *three of these routes are through*

cognitive mediators and the fourth is through a motivational pathway (p. 226).

The first route by which emotions and mood are thought to impact learning and performance is through storage and retrieval processes, or so-called mood-dependent memory (Schunk et al. 2008). The basic idea of mood-dependent memory is that affective states are encoded into long-term memory at the same time as other learned information. As such, these affective states become closely linked to the newly learned information such that retrieval of this information from long-term memory is enhanced if the individual's mood at retrieval matches his mood when the information was encoded (Forgas 2000). So, for instance, if a medical student is in an extremely positive mood at the time he learns a new clinical procedure, he is more likely to recall that procedure if his mood at the time of retrieval is similarly positive.

The second cognitive pathway linking emotions with learning and performance is through the use of different cognitive and metacognitive thinking and learning strategies, which then result in different types of performance outcomes (Pekrun 2006). Recent work in higher education settings suggests that *students who experience negative affect are less likely to use deeper processing strategies, as these require much more engagement and a positive approach to the academic task* (Schunk et al. 2008, p. 226). In contrast, positive emotions are generally thought to result in greater engagement and the use of deeper processing strategies (Pekrun et al. 2002). Of course, as described above, the particular influence of any given positive or negative emotion is likely much more complex than these general assumptions imply.

The third cognitive route by which emotions influence learning and performance is through their impact on cognitive resources. Specifically, both positive and negative emotions have been shown to consume working memory resources by focusing attention on the object of the emotion (Pekrun & Stephens 2010). That is, emotions take up working memory space and can negatively impact an individual's cognitive load, where cognitive load refers to the limitations in processing simultaneous information in working memory. Thus, by taking up working memory space, emotions leave fewer cognitive resources for processing activities essential for task completion (Sweller et al. 1998). In fact, this cognitive load explanation is a hallmark of the empirical work on text anxiety and its negative impact on learning and performance (Zeidner 1998). It is interesting to note, however, that positive emotions do not seem to consume cognitive resources in quite the same deleterious way as negative emotions do (Forgas 2000). This differential and asymmetric finding for the effects of positive and negative emotions is not well understood and clearly requires further exploration (Schunk et al. 2008).

The fourth and final pathway linking emotions with learning and performance is through their effects on intrinsic and extrinsic motivational processes. From this perspective, a positive emotion, such as task-related enjoyment, leads to greater interest and intrinsic motivation for the task; that is, greater motivation to engage in the task for its own sake (Ryan & Deci 2000; see also AMEE Guide No. 59 on self-determination theory). On the other hand, negative emotions like task-related boredom, anxiety, or anger decrease one's interest and intrinsic motivation in the task. At the same time, it is important to consider that some negative emotions can also act to increase one's extrinsic motivation; that is, his motivation to engage in the task as a means to an end (Schunk et al. 2008). For example, fear of reprisal from an instructor for not completing a required activity may result in greater extrinsic motivation, thereby "moving" an individual to comply with the instructor's request. Although extrinsic motivation is considered by most psychologists to be less beneficial and less long-lasting than its more adaptive counterpart, intrinsic motivation (Csikszentmihalyi 1997; Ryan & Deci 2000), it may nonetheless motivate individuals to act – for example, to study, to use various learning strategies, or to seek help when needed. As such, some negative emotions, particularly negative activating emotions, and their resulting extrinsic motivation may improve learning and performance in certain situations (Pekrun 2006).

Empirical findings from non-medical contexts

Using control-value theory as a framework, Pekrun et al. (2002) summarized several correlational studies conducted with university students in traditional classrooms. In general, the researchers found that achievement emotions are related to students' use of learning strategies and various measures of academic success (Pekrun et al. 2002). For example, in a cross-sectional study of 230 university students, negative achievement emotions (anger, anxiety, and boredom) correlated negatively with motivational variables (interest and effort) and measures of learning strategies use (elaboration and metacognitive regulation); whereas positive emotions (enjoyment and hope) related positively to these same outcomes (and all effects were moderate to strong).

In a separate longitudinal study conducted with university students, Pekrun et al. (2000) found that students' negative emotions (hopelessness, boredom, anxiety, anger, and shame), measured early in the semester, longitudinally predicted their end-of-semester grades, as well as their withdrawal from university courses. Moreover, regression coefficients were larger for negative deactivating emotions (hopelessness and boredom) than for negative activating emotions (anxiety, anger, and shame), a finding that corroborates the control-value assumption that deactivating emotions, such as hopelessness and boredom, may be more detrimental to learning and performance than activating emotions, due to the tendency of deactivating emotions to foster disengagement from a learning activity (Pekrun et al. 2002). On the other hand, with the exception of relief (a positive deactivating emotion), the positive activating emotions of enjoyment, hope, and pride positively predicted high achievement (Pekrun et al. 2000).

More recently, in a series of five investigations, Pekrun et al. (2010) explored the linkages between boredom – a particularly pervasive achievement emotion – and university students' appraisals and performance outcomes using exploratory, cross-sectional, and predictive methodologies across two different cultures (North American and German). In line with their expectations, findings across all five studies indicated that both *perceived control* and *perceived value* (Figure 1) in achievement settings related negatively to students' boredom (Pekrun et al. 2010). The authors concluded that *these*

uniformly negative relationships indicate that perceived lack of control over achievement activities and lack of valuation of these activities are crucial individual determinants of boredom in academic achievement settings (p. 545). In other words, students who feel like a learning activity is out of their control and/or is not valuable to them are more likely to experience boredom. Further, the authors found that boredom related positively to attention problems and negatively to intrinsic motivation, effort, and self-regulation of learning activities. Importantly, boredom was also a negative predictor of academic performance, as measured by students' final course grades, even after accounting for prior achievement. Ultimately, these findings suggest that boredom can have deleterious consequences for students' motivation, behavior, and performance. Unfortunately, as the authors noted, there has been a lack of systematic, empirical research on boredom in achievement settings, more than almost any other achievement emotion (Pekrun et al. 2010; Pekrun & Stephens 2010).

Other researchers have recently used control-value theory as a guiding theoretical framework to explore achievement emotions and their consequences in other, more diverse educational contexts. For example, using a group of 481 service academy undergraduates in an online course, Artino (2009) assessed students' control and value beliefs, their negative achievement emotions (boredom and frustration), and several achievement-related outcomes. Results from a series of multiple regressions revealed that students' boredom and frustration were strong predictors of their use of metacognitive control strategies (i.e., planning, goal setting, comprehension monitoring, and performance regulation). Specifically, boredom, a negative *deactivating* emotion, emerged as a negative predictor of metacognition. On the other hand, frustration, a negative *activating* emotion, emerged as a positive predictor of metacogntion. Furthermore, the results revealed that both boredom and frustration were negatively related to students' course satisfaction and continuing motivation to enroll in future online courses. In a follow-up study, Artino and Gehlbach (2009) attempted to replicate these findings in a different group of service academic undergraduates learning online ($N = 302$). Yet again, their results indicated that boredom was a negative predictor of students' use of metacognitive control strategies, while frustration was a positive predictor. The researchers concluded that their findings substantiate the control-value suggestion that negative deactivating emotions, like boredom, are particularly detrimental; whereas negative activating emotions, like frustration, may actually facilitate the use of specific kinds of learning strategies (Pekrun et al. 2002). Stated another way, these results indicate that, under certain conditions, frustration during learning may actually *promote* metacognitive engagement, particularly in high-performing students who have high levels of self-confidence in their academic ability (like the service academy students described above).

Implications for educational practice

When considering the educational implications of achievement emotions, it is helpful to consider the structure and dynamics of control-value theory, as presented in Figure 1. In particular, an assumption can be made that students' achievement emotions, and subsequent motivation, learning, and performance, can be influenced by altering their control and value appraisals relative to achievement activities and outcomes (Pekrun et al. 2007). Influence on these control and value beliefs can be achieved by shaping the learning environments of students in ways that are sensitive to the emotional components of learning and performance (Astleitner 2000). Five broad categories for doing so are described below (Table 2).

Cognitive quality

Pekrun and Stephens (2010) describe the cognitive quality of instructional activities as *their structure, clarity, and potential for cognitive stimulation* (p. 245). Clearly structured, cognitively engaging material with task demands that match students' capabilities have the potential to increase appraisals of control and value, and thus positively influence emotions and subsequent motivation, learning, and performance. If task demands are too high, negative emotions such as anxiety and anger may result. Similarly, if task demands are too low, negative emotions such as boredom and frustration may result. Thus, consistent with theories of intrinsic motivation and flow (Csikszentmihalyi 1997; Ryan & Deci 2000), a laudable instructional goal is to attain equilibrium between the amount of challenge in academic activities and students' capabilities. In medical education, this might include introducing first-year medical students to paper cases on common conditions in medicine versus having them work in a clinic where they may be overwhelmed with the high cognitive and affective demands.

Value

Contemporary educational psychology research suggests that the value of educational activities can (and should) be explicitly addressed by teachers. For example, by clarifying the importance of specific learning activities and content, teachers help students understand the contribution of coursework to the realization of their personal goals, interests, and values (Assor et al. 2002). This idea may be particularly relevant in the early years of undergraduate medical education where students are required to focus on the basic sciences. Attempts to better integrate basic science content with its clinical relevance is likely go a long way toward improving students' emotional experiences (Cooke et al. 2010). Additionally, educators can address value by utilizing authentic learning activities (Evensen & Hmelo 2000). Integrating course content with authentic, real-world cases can not only capture students' immediate interest but also helps them appreciate the broader relevance and importance of what they are learning (Bransford et al. 2000). However, educators are cautioned to carefully consider the complexity of their authentic activities, as overly complex problems have the potential to quickly overwhelm students' working memory capacity and, consequently, can deleteriously impact learning (for a complete review of the limitations of problem-based learning and other

Table 2. Instructional strategies that can positively influence students' achievement emotions and subsequent motivation, learning, and performance.

Category	Definition	Instructional strategies
Cognitive quality	The structure and clarity of instructional activities and their potential for cognitive stimulation	– Clearly structure activities – Ensure task demands match students' capabilities
Value	The importance, use, and value of instructional activities	– Explicitly link basic science content to its clinical relevance – Utilize authentic learning activities that do not overwhelm students' working memory capacity
Control and confidence	Students' personal control over and confidence in successfully completing instructional activities	– Help students identify and set challenging, proximal goals – Provide students with timely, honest, and explicit feedback
Autonomy support	The extent to which instructional activities support student independence and self-regulation	– Provide students with choice of instructional activities – Seek to understand what motivates students and nurture those inner motivational resources – Use non-controlling language in the classroom and clinic – Provide explanatory rationales to reveal why certain course activities or student behaviors are truly worth the effort – Display patience and allow time for self-paced learning to occur – Acknowledge, accept, and even welcome students' expressions of negative affect as it relates to tasks that may, in fact, be boring or difficult
Goal structures	The extent to which school environments, classroom structures, and teacher behaviors encourage mastery-oriented goals	– Ask students to engage in personally meaningful and challenging tasks with flexible participation structures – Give students the opportunity to participate in creating the rules and regulations that affect their academic activities – Recognize and value mastery-goal ideals, such as effort, risk taking, and creativity – Group students based on shared interests and for the purposes of facilitating learning and interaction – Assess students formatively using grading policies and feedback procedures that evaluate progress and promote mastery of essential knowledge and skills

types of minimally-guided instruction, see Mayer 2004; Kirschner et al. 2006). In fact, in their study of clinical reasoning among a group of 133 second-year medical students, La Rochelle et al. (in press) found evidence of the need to balance authenticity and cognitive load in medical contexts. Specifically, their results revealed that authenticity of instructional formats did not significantly improve clinical reasoning performance. Ultimately, the authors suggested that while increased instructional authenticity may be beneficial in certain contexts, it is far from a panacea.

Control and confidence

In addition to explicitly addressing instructional value, contemporary educational research also suggests that students' perceptions of personal control can (and should) be explicitly targeted by educators. For example, research across many educational settings indicates that teachers can help students build and maintain their sense of control or personal agency – what Bandura (1997) has called their self-efficacy. Self-efficacy beliefs have been defined as *people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances* (Bandura 1986, p. 391). Although many strategies have been shown to enhance students' self-efficacy for learning – and thereby benefit their achievement emotions and subsequent motivation, learning, and performance – two specific approaches are suggested here. First, educators can help students identify and set challenging, proximal goals. When students set realistic goals, they tend to be more motivated to perform than students who are given no goals or who are simply told to try their best (Locke & Latham 1990). Furthermore, according to Bandura (1997), students who set a goal are likely to experience an initial sense of self-efficacy in their ability to achieve the goal and are also apt to make a commitment to attempt it. As students progress, *they engage in activities that they believe will lead to goal attainment: attend to instruction, rehearse information to be remembered, expend effort, and persist* (Schunk 1991, p. 213). In medical education, this could involve helping students carefully construct short-term goals and expectations for a clerkship, which are returned to on a weekly basis, versus having the students attempt to set their own goals with no input or calibration from teachers.

A second strategy for boosting students' self-efficacy for learning is to provide them with timely, honest, and explicit feedback (Bandura 1997; Hattie & Timperley 2007; van de Ridder et al. 2008). Effective feedback from the instructor reveals progress in relation to students' goals, helps students adjust the level or direction of their effort, and develops students' self-efficacy beliefs as they experience success and observe progression toward goal completion (Locke & Latham 2002). Furthermore, instructor feedback can directly shape students' outcome emotions, which can then facilitate positive approaches to future learning and performance (Pekrun et al. 2007).

Autonomy support

Educational environments that support student autonomy can increase perceived control and, by meeting our basic

psychological need for autonomy (Ryan & Deci 2000), can also enhance the perceived value of achievement activities (Pekrun & Stephens 2010). Autonomy-supporting teaching behaviors include, for example, providing students with choice of instructional activities; seeking to understand what motivates students and nurturing and developing those inner motivational resources; using non-controlling language in the classroom and clinic; providing explanatory rationales to reveal why certain course activities or student behaviors are truly worth the effort; displaying patience and allowing time for self-paced learning to occur; and acknowledging, accepting, and even welcoming students' expressions of negative affect as it relates to tasks that may, in fact, be boring or difficult (Reeve 2009).

Goal structures

Motivation theorists have a long tradition of exploring the types of goals individuals pursue in achievement situations. Known as achievement goal theory, this framework views individual behavior as *purposeful, intentional, and directed toward the attainment of certain goals* (Meece et al. 2006, p. 490). Further, achievement goal theorists have used this framework to analyze the influence of different school environments, classroom structures, and teacher behaviors on student emotion, motivation, and learning (Pintrich 2000; Pekrun et al. 2006, 2009). Early research on achievement goals centered on two contrasting types of achievement goals with various labels, including learning versus performance, mastery versus ability focused, and mastery versus performance (Meece et al. 2006). Despite a fair amount of debate as to whether these goal pairs represent analogous constructs, most contemporary motivation researchers view these goal sets as *having sufficient overlap to be treated as conceptually similar constructs* (Meece et al. 2006, 490). Today, the most common labels used to describe these pairs of achievement goal orientations are "mastery" and "performance" goals.

Individuals who endorse mastery goals tend to focus on developing their abilities, mastering new skills, accomplishing challenging tasks, and trying to truly understand learning materials. They evaluate their success in terms of self-improvement and enhanced competence. Consistently, students' endorsement of mastery goals has been found to be associated with positive outcomes such as improved self-efficacy, greater persistence and effort, self-regulated learning, and positive emotions (Kaplan & Maehr 2007; Pekrun et al. 2009).

Whereas mastery goals refer to the purpose of developing competence, performance goals refer to the purpose of *demonstrating* competence. Individuals who endorse performance goals tend to focus on outperforming others and using social comparison standards to judge their own ability and performance (Meece et al. 2006). They evaluate their success in terms of doing better than their peers and exceeding normative performance standards. Although empirical findings have been inconsistent, students' endorsement of performance goals has been associated with maladaptive patterns of cognition, affect, and behavior (Kaplan & Maehr 2007). For instance, students' strong endorsement of performance goals has been linked to the use of surface rather than deep learning strategies and with negative emotions when tasks become too difficult (Kaplan & Maehr 2007).

In light of the largely adaptive nature of mastery goals and the often times maladaptive nature of performance goals, achievement goal theorists have focused considerable effort on understanding the influence of school environments, classroom structures, and teacher behaviors on students' goal orientations and subsequent emotions, motivation, and learning. Indeed, results across more than 20 years of empirical research suggest that teachers, through their use of various instructional practices, create different goal structures, which then influence students' achievement goal orientations (Wolters et al. 1996; Urdan et al. 1998; Wolters 2004). In short, *when students perceive their classrooms or schools as emphasizing effort and understanding, they are more likely to adopt mastery-oriented goals* (Meece et al. 2006, p. 495). On the other hand, when students perceived their school environment as focused on competition for grades and social comparisons of ability, they are more likely to adopt performance-oriented goals. Based on such theoretical assumptions and corroborating empirical findings, several beneficial instructional practices have been deemed mastery goal structures with the potential to encourage student adoption of mastery-oriented goals. These practices – many of which could be easily applied in medical education contexts – include asking students to engage in personally meaningful and challenging tasks with flexible participation structures; giving students the opportunity to participate in creating the rules and regulations that affect their academic activities; recognizing and valuing mastery-goal ideals, such as effort, risk taking, and creativity; grouping students based on shared interests and for the purposes of facilitating learning and promoting interaction (as opposed to encouraging competition between groups); and assessing students formatively using grading policies and feedback procedures that evaluate progress and promote mastery of essential knowledge and skills (as opposed to policies and procedures that focus on students' performance relative to others; Epstein 1989; Maehr & Midgley 1996; Kaplan & Maehr 2007).

Emotions in medical education: A proposed research agenda

In the last 20 years, many strides have been made with respect to the structure and function of achievement emotions in higher education and their impact on students' motivation, learning, and performance. Despite this growth in empirical research, we still know very little about how emotions influence medical trainees in both classroom and clinical settings. In fact, aside from the innovative work being done to better understand student burnout (Dyrbye et al. 2010), a search of the medical education literature reveals very few studies considering the emotional components of medical training and their impacts on important outcomes. In a recent letter, Artino and Durning (2011) highlighted this gap and called for more systematic research in this area. The authors' argued that *if we medical education researchers really want to improve medical education, we must broaden "what counts" as important and begin*

seriously exploring the role of emotion in learning (Artino & Durning 2011, p. 275). The journal editor agreed and posited that clinicians' understanding of their own emotional reactions to patients *may even be able to improve diagnostic accuracy* (Kanter 2011, p. 273). Certainly this and many other reasonable hypotheses about the associations between emotions and performance require systematic testing in medical contexts. Moreover, when considering the impact of emotions on outcomes, questions of how much, under what circumstances, and for which trainees all must be answered (Artino & Durning 2011).

Limited empirical work in medical education suggests that, just like in other higher education settings, achievement emotions have important links to academic outcomes. For example, in a recent longitudinal study, Artino et al. (2010) examined the relationships between 136 second-year medical students' motivational beliefs, achievement emotions, and academic achievement. Their findings, based on structural equation modeling techniques, suggest that students' beliefs and emotions are important contributors to their academic achievement. In particular, the researchers found that task value beliefs (i.e., students' beliefs about the importance and usefulness of a clinical reasoning course) were positively associated with their course-related enjoyment and were negatively related to boredom; whereas self-efficacy beliefs were negatively associated with course-related anxiety only. Furthermore, students' course-related enjoyment was positively associated with their national board shelf examination scores; whereas anxiety and boredom were both negatively related to course examination grades. Finally, the overall structural model accounted for considerable variance in each of the achievement outcomes: $R^2 = 0.20$ and 0.14 for the course examination grade and national board shelf examination score, respectively. The researchers concluded that their results provide support for Pekrun's (2006) control-value theory and suggest that medical students' control and value beliefs, as well as their achievement emotions, may be important contributors to their academic achievement in introductory clinical reasoning course (Artino et al. 2010).

Aside from this study, and recent conversations about the need to consider achievement emotions in medical training (Elnicki 2010; Taylor 2010), there remains a dearth of systematic research in this area of inquiry. Accordingly, it seems the time has come to study achievement emotions in medical education (Elnicki 2011; Kanter 2011), especially given the movement to CBME in which achievement (outcomes) is the primary metric of individual and program effectiveness. Although the relevant questions that need answering are many, and the methodologies appropriate for answering those questions are varied, we offer several suggested questions and associated research methodologies below.

How do control and value appraisals influence medical students', residents' (registrars'), and practicing physicians' achievement emotions?

Pekrun's (2006) control-value theory offers several predictions for how perceived control and value beliefs might influence various achievement emotions. However, we have only just begun to confirm these hypothesized relationships in medical contexts. Appropriate research methodologies for better understanding these relations include longitudinal survey designs, diary studies, and the use of ecological momentary assessments (i.e., repeated sampling of students' current beliefs, emotions, and behaviors in real time and in their natural environments; see Shiffman et al. 2008).

Are there other theories of emotion that are more appropriate to medical education contexts?

To date, there are very few comprehensive theories on the structure and function of emotions in academic settings. Control-value theory (Pekrun 2006), while seemingly appropriate to medical education, may not adequately explain emotions as they are experienced by medical trainees. As such, there is a need to further test the assumptions of control-value theory while, at the same time, exploring (or developing) other theoretical models that might better account for the structure, dynamics, and functions of emotions in medical students. It is only through systematic, theoretically grounded research that medical education researchers will be able to generate cumulative, generalizable knowledge.

How do achievement emotions vary across the medical education continuum?

Achievement emotions are context specific; that is, they vary across achievement activities and outcomes. Context specificity is a well-known phenomenon in medical education, though research has not focused on exactly why it occurs, nor has it explored emotional components of context specificity. Recent work suggests that context specificity is a multidimensional phenomenon, where environment and interactions may be critical, and where non-traditional analytic paradigms, such as nonlinearity, are likely needed (Durning et al. 2010). Further, we lack understanding about the dimensions, antecedents, and functions of different emotions experienced in various medical education contexts. Therefore, we need longitudinal studies that consider trainee emotions across the medical education continuum, as well as during the wide range of specific situations that students encounter duri the different phases of medical training.

How can medical educators enhance students' achievement emotions to improve learning?

Although practical considerations for how to enhance students' emotions can be deduced from the theoretical assumptions described above, we need related empirical evidence in the form of intervention studies. Such studies are a critical step toward gathering evidence-based conclusions on how to design classroom instruction, learning environments, and educational systems that are sensitive to the emotional components of learning and performance (Astleitner 2000).

How can emotions be reliably measured in medical trainees?

The measurement of students' achievement emotions is still in its infancy (Schutz & Pekrun 2007). Tools and assessment methodologies need to be developed that allow researchers to explore different emotions in valid and reliable ways. Further, such measures should take into consideration the dynamic nature of emotions. Although self-report instruments have been used with some success (Pekrun et al. 2005), these tools should be complimented by other real-time estimates of emotions and emotional processes. Studies in medical education should attempt to adapt novel methodologies from other fields, including, for example, neuropsychological measures, peripheral physiological activation assessments, behavioral observation of facial and postural expressions of emotions (e.g., facial-feature analysis; Ekman & Rosenberg 1997), and ecological momentary assessments (Shiffman et al. 2008).

Summary

In this AMEE Guide, we considered the emergent theoretical and empirical work on human emotion and how this work can inform the theory, research, and practice of medical education. In particular, we defined emotion, in general, and achievement emotions, in particular. Next, we detailed one of the leading contemporary theories of achievement emotions, control-value theory (Pekrun 2006), and distinguished between different types of achievement emotions, their proximal antecedents, and their consequences for motivation, learning, and performance. Conceptually, this theory presents an integrative framework for understanding students' emotions and provides researchers with a guide for conducting more detailed study of emotion in medical education contexts.

In this AMEE Guide, we also reviewed the empirical support for control-value theory from non-medical fields and suggested several important educational implications. Of particular importance is the notion that instructors can and should create learning environments that foster a high degree of control and value for students. In doing so, instructors improve their chances of positively impacting students' achievement emotions, as well as their subsequent motivation, learning, and performance. Finally, we ended with a discussion of the need for more research on achievement emotions in medical education, and we proposed several key research questions we believe will facilitate our understanding of achievement emotions and their impact on important educational outcomes.

If our aim is to truly improve medical education, it seems the time has come for a rigorous, theory-based research agenda that includes consideration of "non-cognitive" constructs like emotion.

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