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INCREMENTAL EFFECTS OF DISCRETE EMOTIONS AND TARGETED POSITIVE EMOTION CONTROL STRATEGIES IN THE CONTEXT OF COMPLEX SKILL LEARNING

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INCREMENTAL EFFECTS OF DISCRETE EMOTIONS AND TARGETED POSITIVE EMOTION CONTROL STRATEGIES IN THE CONTEXT OF COMPLEX SKILL LEARNING

A DISSERTATION APPROVED FOR THE
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In loving memory of my grandparents Rod and Jan Larson. Although you were not here to celebrate, you helped support me along the way to this dream and you always made sure I knew how proud you were of my accomplishments! I will forever be thankful for that and the time that I had with you.

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Abstract

Although the importance of emotions to self-regulation has been noted in the extant literature, little empirical research has examined how emotions are related to performance in complex skill learning. Using existing data of videogame playing, I first examined the incremental prediction of discrete emotions above general dimensions of positive and negative affect. I found that discrete emotions provided incremental prediction above general dimensions of affect, but that this was clearest and most consistent for positive activating emotions. These results suggest that emphasizing specific emotions may be more useful than generally focusing on negative or positive emotions in emotion control interventions. In Study 2, I conducted a laboratory study involving undergraduate males playing the same videogame as in Study 1. I examined two emotion control strategies, one targeting positive activating emotions (i.e., enthusiastic, excited, happy) and the other targeting positive deactivating emotions (i.e., calm, relaxed, at ease) in comparison to a no emotion control strategy group (i.e., the control condition). Using discontinuous growth modeling that distinguishes acquisition and adaptive performance, quantitative analyses showed that the strategy targeting positive deactivating emotions improved performance across acquisition and adaptation. Individuals in the positive deactivating and no emotion control group performed similarly. Additionally, the emotion control strategies did not increase the respective emotion scores. Qualitative analyses showed that individuals in the positive deactivating condition mentioned feeling *calm*, *relaxed,* and *at ease* was useful for reducing negative emotions and improving cognition and focus, both which likely improved performance. Results are discussed in regards to the importance of tailoring emotion control strategies to the performance context.

Incremental Effects of Discrete Emotions and Targeted Positive Emotion Control Strategies in the Context of Complex Skill Learning

Individuals are likely to experience a wide range of emotions as they navigate the complexities of modern society. As such, an individual's most important asset may be their ability to effectively regulate their emotions, cognitions, and behaviors (Porath & Bateman, 2006). Self-regulation is defined as the "processes that guide goal directed activities over time and across changing circumstances" (Karoly, 1993, p. 25). When learning complex tasks and adapting to unforeseen changes, it is crucial for individuals to effectively direct their attentional resources (Kozlowski et al., 2001). Thus, an important concept in theories of learning and development is self-regulated learning, defined as the "modulation of affective, cognitive, and behavioral processes throughout a learning experience to reach a desired level of achievement" (Sitzmann & Ely, 2011, p. 421). Despite the plethora of empirical research on self-regulated learning, research on the role of emotions has been limited (Sitzmann & Ely, 2011).

The broader emotion regulation literature suggests that strategies for regulating emotions involve maintaining, increasing (i.e., up-regulating), or decreasing (i.e., down-regulating) moods and emotions (Gross, 1998; Parrot, 1993). In particular, much of this research has centered on how individuals should up-regulate positive moods and emotions or down-regulate negative moods and emotions (Parrot, 1993). Within the self-regulated learning literature, emotion regulation is discussed in terms of "emotion control" (i.e., skills to reduce negative emotions during task engagement; Kanfer, 1996). However, despite emotion control being a central component in self-regulated learning (Sitzmann & Ely, 2011), there is a paucity of empirical research regarding the effects of particular emotion control strategies.

The current advice from the extant literature is that individuals should keep negative emotions at bay, be calm, and focus on positive thoughts (Bell & Kozlowski, 2008; Kanfer & Ackerman, 1989; Keith & Frese, 2005; Niessen & Jimmieson, 2016). However, in the published empirical literature, I am aware of only two studies (i.e., Bell & Kozlowski, 2008; Kanfer & Ackerman, 1996) that have incorporated an experimental manipulation targeting emotion control while the rest relied have on self-report measures. Additionally, the two experimental studies primarily targeted emotions based on their positive (pleasantness) versus negative (unpleasantness) affectivity by prompting participants to suppress negative thoughts and increase positive thoughts or by instructing participants to replace negative thoughts with positive thoughts (Bell & Kozlowski, 2008; Kanfer, Ackerman, & Heggestad, 1996). Consequently, by focusing on the positive or negative affectivity of emotions alone, current strategies may be somewhat misguided as there is more recent research suggesting that another dimension—namely, activation potential (i.e., arousal)—may influence emotion-performance relationships (De Dreu, Baas, & Nijstad, 2008; Jorgensen et al., under review; Pekrun, Goetz, Titz, & Perry, 2002; To, Fisher, Ashkanasy, & Rowe, 2012). Furthermore, contemporary research has found that discrete emotions exhibit specific differential and incremental relationships with performance (Lee & Allen, 2002; Levine et al., 2011). Thus, emphasizing particular discrete emotions in an emotion control strategy may be more effective than focusing generally on positive over negative emotions.

Given that relatively little is known about emotion-performance relationships in the context of skill acquisition and adaptation, it seems misguided to propose an emotion control strategy without first examining a range of emotions and their relationships with performance over time and circumstances. Therefore, the purpose of this dissertation was to address gaps in the self-regulated learning literature by examining a more nuanced emotion control strategy that is informed by previous empirical research on the incremental prediction by discrete emotions in predicting performance in skill acquisition and adaptation. A two-study approach seemed to be appropriate to developing and comparing specific emotion control strategies. In the first study, I used existing data (i.e., Huck, Day, Jorgensen, Westlin, & Richels, 2019; Jorgensen et al., under review) and examined emotion-performance relationships at the between- and within-person levels for both discrete emotions and the general dimensions of positive (i.e., pleasant) and negative (i.e., unpleasant) affect. The analyses were used to determine whether specific discrete emotions or a general dimension should be targeted in an emotion control manipulation by examining the magnitude and consistency of the relationships. I found that in general, positive activating discrete emotions consistently added incremental prediction over and above the general dimension of positive affect at both levels of analysis, whereas negative deactivating emotions consistently added incremental prediction over and above negative affect primarily at the within-person level of analysis. At both levels of analysis, positive deactivating and negative activating emotions did not consistently add incremental prediction over positive and negative affect, respectively. Additionally, depending on the particular emotion and level of analysis, the direction of some of the effects for positive deactivating and negative activating emotions were opposite their respective zero-order correlations. Overall, positive activating emotions yielded the clearest and most consistent pattern of effects, whereas the other emotions yielded more nuanced patterns.

The second study involved conducting an exploratory experiment informed by the results of the first study to compare two different positively valenced emotion control strategies. Given the results of Study 1 suggested that positive activating emotions provided clear and consistent incremental prediction over and above positive affect, it appeared that a manipulation emphasizing specific positive discrete emotions was sensible to examine rather than a manipulation emphasizing positive or negative emotions in general. This targeted approach is consistent with arguments in the scholarly literature for studying emotions at the discrete level because discrete emotions provide valuable information beyond what is provided by general dimensions (Brief & Weiss, 2002; Shockley, Ispas, Rossi, & Levine, 2012; Smith & Ellsworth, 1985). Additionally, given that discrete emotions may be differentiated based on a number of underlying dimensions (Smith & Ellsworth, 1985), I determined that it would be beneficial to explore two variations of a targeted emotion control strategy—one targeting positive activating emotions (i.e., enthusiastic, excited, happy) and a second targeting positive deactivating emotions (i.e., calm, relaxed, at ease)—in comparison to a no emotion control strategy condition (i.e., the control condition).

I sought to contribute to the literature in several ways. First, by exploring two variations of an emotion control strategy that targeted specific aspects of emotion control, I was able to examine if the proposed strategies differentially benefit learners and could thus lay the foundation for viable alternatives to the more general strategies previously examined in the literature. Second, by incorporating a control group in my proposed study, I was able to examine cause-and-effect relationships. Much of the existing, empirical literature on emotion-performance relationships is based on correlational designs, and previous studies incorporating control group comparisons have not shown straightforward, direct benefits of emotion control strategies on complex skill learning. For example, some research has shown that the benefits of emotion control might benefit low- but not high-ability learners and with respect to transfer performance but not acquisition performance (Kanfer & Ackerman, 1996). Other research has shown that a more general emotion control manipulation did not have a direct impact on performance, but it did have an indirect impact on important mediators of performance (i.e., state anxiety, self-efficacy; Bell & Kozlowski, 2008). Given these discrepancies, more research is needed to investigate the effectiveness of different emotion control strategies. Last, by incorporating two variations of a positively valenced emotion control strategy, I was able to examine if different arousal aspects of emotion control were more beneficial. By extending the current literature, the present study not only informs research regarding emotion control but it also speaks to meta-analytic results suggesting null effects for emotion control in learning contexts (Sitzmann & Ely, 2011).

Both Study 1 and Study 2 in this dissertation incorporated a task-change paradigm in the context of learning a complex computer task (Lang & Bliese, 2009) whereby participants first underwent a period of basic instruction and skill acquisition followed by a period in which they were confronted with an unforeseen change in task demands that required adaptive behavior. Repeated measures of objective performance and self-reports of emotions were taken during both skill acquisition (i.e., pre-change) and adaptation (i.e., post-change). Discontinuous growth modeling was used to examine the effects of discrete emotions (Study 1) and emotion control (Study 2) on both acquisition and adaptation performance.

Self-Regulation and Complex Skill Learning

Much of self-regulated learning boils down to the allocation of attentional resources (Sitzmann & Ely, 2011). In the initial phase of learning, attentional demands are at a premium because strategies for effective performance are unclear, and individuals must focus on acquiring the relevant facts about task demands and procedures (Anderson et al., 2004). As task demands and procedures become more familiar with practice, fewer attentional resources are needed to execute one's learned task strategies (Kanfer & Ackerman, 1989). With more practice, there are diminishing returns to the allocation of attentional resources as the limits of performance are approached and performance plateaus (Kanfer & Ackerman, 1989). However, part of the plateauing can also be explained by individuals' tendency to settle on effective yet suboptimal task strategies (Dörner, 1980). As such, self-regulation, in particular the motivation to sustain the allocation of attentional resources to task demands, is needed to prevent settling on suboptimal solutions and to promote learning and refining more effective task strategies (Dörner, 1980; Hardy, Day, & Arthur, 2019; Kanfer & Ackerman, 1989).

Focused attention is also important when individuals have to adapt learned strategies in response to unforeseen changes in task demands (Bell & Kozlowski, 2008; Lang & Bliese, 2009). One component of adaptation—transition adaptation—speaks to the amount of change (i.e., loss) in performance immediately following changes in task demands (Lang & Bliese, 2009). At this point, effective self-regulation entails allocating attentional resources to discovering and making sense of new demands and determining which strategies need to be modified or replaced altogether. Similar to acquisition, effective task strategies are unclear. The other component of adaptation—reacquisition adaptation—speaks to the rate of change (i.e., gains) in performance following the task changes. One could argue that the combination of learning new strategies and unlearning old habits makes reacquisition adaptation inherently more difficult compared to acquisition. Consistent with research showing slower reacquisition adaptation compared to acquisition (e.g., Lang & Bliese, 2009), successful adaptation likely puts an especially high premium on self-regulation and the proper allocation of attentional resources (Baard, Rench, & Kozlowski, 2014; Niessen & Jimmieson, 2016). In general, emotions are linked to learning and performance by virtue of how they influence the allocation of attentional resources toward or away from task demands (Beal, Weiss, Barros, & MacDermid, 2005; Kanfer & Ackerman, 1996; Seo, Barrett, & Bartunek, 2004).

Emotion Control

Individuals are likely to feel overwhelmed and have negative thoughts about themselves when initially learning a complex task (Kanfer & Ackerman, 1996). Consequently, attentional resources may be diverted from on-task thoughts (e.g., acquiring task demands and procedures) to off-task thoughts (e.g., self-doubt), and learning may be hindered (Kanfer et al., 1996). As such, "skills that involve the use of self-regulatory processes to keep performance anxiety and other negative emotional reactions (e.g., worry) at bay during task engagement" (i.e., emotion control; Kanfer et al., 1996, p. 186) are thought to be important early in skill acquisition. Additionally, emotion control may be important when learners are trained in an active-learning context (Bell & Kozlowski, 2009; Keith & Wolff, 2015). With active learning, learners are allowed to explore to-be-learned tasks at their own pace and thus are given much of the responsibility for what they learn during training. In comparison to proceduralized instruction, learners in active-learning training might experience more frustration or anxiety because it may be unclear what they should be doing and because they are not provided with explicit instructions for how to perform the task (Bell & Kozlowski, 2009; Keith & Wolff, 2015).

Despite the notion that engaging in emotion control should benefit learning and performance, results supporting the effectiveness of emotion control are mixed. Some researchers have found that emotion control benefits adaptive performance (Bell & Kozlowski, 2008; Kanfer & Ackerman, 1996; Keith & Frese, 2005), whereas others have found that it negatively impacts performance (Porath & Bateman, 2006). Additionally, recent meta-analytic findings have suggested that emotion control has null effects on learning (Sitzmann & Ely, 2011). These discrepancies in results may be, in part, due to the way that emotion control was studied or due to the outcome that was measured. For example, Porath and Bateman (2006) used a self-report measure of emotion control that asked participants about how they kept on track by regulating their moods, and the outcome measured was job performance. On the other hand, both Bell and Kozlowski (2008) and Kanfer and Ackerman (1996) used an emotion control manipulation that prompted individuals to engage in emotion control during training and the outcome measured was performance on a transfer task. With respect to meta-analytic null findings, as Sitzmann and Ely (2011) noted how very few studies in the extant literature have examined emotion control, and thus more research is needed to understand how emotion control influences learning and performance.

Emotion Control Strategies

Significant gaps still exist regarding our knowledge of the aspects of emotion control strategies that benefit complex task learning. One significant problem is that very little is known about emotion-performance relationships in complex skill learning. Consequently, it is difficult to implement an emotion control strategy without first understanding emotion-performance relationships. Jorgensen et al. (under review) sought to further our understanding of emotion-performance relationships by studying the dynamics of emotions and performance across periods of skill acquisition and adaptation. In general, Jorgensen et al.'s (under review) results suggest that certain emotions should be targeted more so than others, positive activating emotions (i.e., excited, enthusiastic, happy) in particular.

Second, very little empirical research has studied the relationship between emotion control strategies and complex skill learning. To our knowledge, only two studies have used an emotion control manipulation in the context of complex skill learning: Bell and Kozlowski

(2008) and Kanfer and Ackerman (1996). Kanfer and Ackerman (1990; 1996) developed an emotion control strategy that instructed participants to reduce negative thoughts and increase positive thoughts in the context of learning a computer simulation of air traffic control. Emotion control instructions were provided to participants prior to beginning the training and reminders were included in between each training trial. An example reminder given to participants was: "Use the EMOTION CONTROL strategy while performing the task. That is, do not get upset or worry. Adopt a positive, 'CAN DO' attitude. This will improve your performance" (Kanfer & Ackerman, 1990, p. 35). In addition to the emotion control group, there was also a motivation control group. Participants in the motivation control group were provided with instructions that told them to continue to expend effort towards the task. Reminders were removed when participants completed the transfer task. Emotion control was beneficial to low-ability learners as they made fewer errors in the early stages of the transfer task compared to low-ability learners in the motivation control and control conditions (Kanfer & Ackerman, 1990; 1996). However, the strength of this effect decreased over time, such that the differences between conditions became smaller as participants learned the task. For high-ability participants, there was no effect of emotion control. Additionally, participants in the emotion control condition reported fewer negative self-reactions compared to those in the motivation control and control conditions (Kanfer & Ackerman, 1990; 1996).

In contrast to instructions not to get upset or worry, other research suggests that suppression (i.e., reducing or inhibiting emotions) may be detrimental as it can consume attentional resources (Muraven & Baumeister, 2000; Richards & Gross, 2000). Thus, engaging in suppression may not be the most worthwhile strategy when learning a complex skill, as attentional resources are needed to learn the task. The emotion control strategy developed by

Bell and Kozlowski (2008) prompted participants to focus on replacing negative or self-defeating thoughts with positive, or constructive thoughts in the context of learning a radar-tracking simulation. Prior to the training, participants were told about the relationship between specific negative emotions (i.e., anxiety, frustration) and learning and performance in addition to being told about the importance of self-talk (Neck & Manz, 1992). Participants were also given emotion control statements (e.g., “Remember, worry won’t help anything” and “This task may be challenging, but I know I CAN do it”, p. 303) and were prompted to use these statements, as well as to develop others that they thought were applicable. Reminders were displayed to participants on their computer and in the room throughout training but were removed when participants were tested on the transfer task. Bell and Kozlowski (2008) found that emotion control was not directly related to performance. However, those individuals that received the emotion control training reported less anxiety and in turn, this increased self-efficacy and positively impacted transfer performance.

Given the literature regarding emotion regulation (Butler et al., 2003; Gross & John, 2003; Muraven & Baumeister, 2000; Richards & Gross, 2000) and Jorgensen et al. (under review), there are several concerns worth noting about the emotion control strategies examined in the extant empirical literature. As mentioned previously, research suggests that suppression consumes cognitive resources (Muraven & Baumeister, 2000; Richards & Gross, 2000), and thus it may not be a beneficial emotion control strategy for learners. Additionally, although Jorgensen et al. (under review) did not look at emotion control directly, they found emotion-performance relationships that can inform emotion control strategies. For example, the negative emotion-performance relationships for negative emotions were weaker than the positive emotion-performance relationships for positive emotions. Therefore, it could be that targeting negative emotions and/or thoughts in prompts may be less beneficial than targeting positive emotions and/or thoughts. Additionally, emotion control strategies may be targeting the wrong positive emotions. Jorgensen et al. (under review) found that positive emotion-performance relationships were stronger for positive activating emotions (e.g., enthusiastic, excited) than positive deactivating emotions (e.g., calm, relaxed). Thus, emotion control strategies prompting learners to stay calm and relaxed might be less beneficial than strategies prompting them to be enthusiastic or excited. In general, there is a lack of clarity regarding which emotions should be targeted in emotion control strategies.

A Two-Study Approach

Although previous emotion control strategies exist, the premise of both Study 1 and Study 2 is that emotion control strategies should be context-specific based on what is known about emotion-performance relationships in a given context. Moreover, there is a debate regarding how emotions should be categorized and there are discrepant findings regarding emotion-performance relationships based on these categorizations. Thus, it is important to first examine emotion-performance relationships in a given context before developing and applying an emotion control intervention. If the results show that general dimensions of positive or negative affect significantly predict performance and positive or negative discrete emotions do not add incremental effects in these predictions, then it would suggest that strategies targeting general positive or negative thoughts or emotions would be viable to compare. However, if the results show that certain positive or negative discrete emotions yield incremental prediction over positive or negative affect when predicting performance, then it would suggest that strategies targeting specific discrete emotions would be viable to compare.

Study 1: Discrete Versus Dimensional Approaches to Studying Emotions

The purpose of Study 1 was to examine if there is any benefit to studying emotions at a discrete level versus a dimension level in the context of learning a complex computer task. Specifically, I examined if discrete emotions provide incremental prediction in skill acquisition and adaptation above what was accounted for by the dimensional—positive and negative—aspects of emotions. I also examined whether there were variations in the incremental prediction provided by positive or negative discrete emotions. In the sections that follow, I first review the literature on dimensional and discrete approaches to examining emotions. Then, I focus on studies that have examined the incremental prediction of discrete emotions over and above general dimensions. Last, I present the specific hypotheses and research questions to be addressed by Study 1.

Dimensional Approach

There has been a tendency in the literature to describe and examine emotional experiences in terms of broad dimensions, rather than focus on discrete emotions (see Figure 1 for an overview of the dimensions and discrete emotions; Barsade, Brief, & Spataro, 2003; Brief & Weiss, 2002; Weiss & Cropanzano, 1996). Researchers argue that a dimensional approach to studying emotions is appropriate as discrete emotions "share underlying variance that can be explained by a simpler dimensional structure" (Shockley et al., 2012, p. 378). Positive affect and negative affect are the two general dimensions that have received most of the attention in the scholarly literature (Barsade et al., 2003; Watson, Clark, & Tellegen, 1988; Watson & Tellegen, 1985; Weiss & Cropanzano, 1996). Trait, or dispositional affect describes an individual's stable feelings over time, whereas state affect refers to an individual's feelings in the moment and includes both moods and emotions (Watson & Clark, 1984). An individual who is high on trait positive affect tends to experience emotions that are pleasant and activating, whereas an individual that is high on trait negative affect tends to experience emotions that are unpleasant and distressful (Watson et al., 1988). Excited and happy are examples of emotions that are subsumed under high positive affect, whereas drowsy and sleepy are examples of emotions that are subsumed under low positive affect. Distressed and nervous are examples of emotions that are subsumed under high negative affect, whereas calm and relaxed are examples of emotions that are subsumed under low negative affect. Accordingly, positive and negative discrete emotions are captured under the broad dimensions of positive and negative trait or state affect (moods). Positive moods[1] (affect) and emotions should benefit performance via broadened attention to task demands and an approach orientation, whereas negative moods (affect) and emotions should harm performance via allocation of attentional resources to off-task thoughts (e.g., self-doubt) and an avoidance orientation (Beal et al., 2005; Cacioppo, Gardner, & Berntson, 1999; Carver & Scheier, 1998; Fredrickson & Branigan, 2005; Seo et al., 2004). In support of this notion, emotion-performance relationships tend to be positive and negative for positive and negative trait and state affect, respectively (Kaplan, Bradley, Luchman, & Haynes, 2009; Koy & Yeo, 2008; Shockley et al., 2012).

In contrast, other researchers have proposed that emotional experiences should be categorized using the two dimensions of valence and activation potential (Posner, Russell, & Peterson, 2005; Russell, 1980). Valence refers to whether or not an emotion experienced is pleasant (i.e., positive) or unpleasant (i.e., negative). Activation potential refers to whether the emotion experienced involves high (i.e., activating emotion) or low arousal (i.e., deactivating

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[1]Affect is a term used when generally referring to a broad range of emotions, moods, and dispositions (Barsade & Gibson, 2007). Further, Briner and Kiefer (2005) note that “the term affect is typically used generally as an umbrella term for affective phenomena though the expressions “positive affect” and “negative affect” usually refer to mood” (p. 286). As such, I refer to affect in some places and mood in some places to stay consistent with the literature I am referencing.

emotion). From this perspective, specific emotions fall on a circumplex based on combinations of valence and activation potential (Posner et al., 2005; Russell, 1980). Happy and excited are examples of positive activating emotions, whereas calm and relaxed are examples of positive deactivating emotions. With respect to negative emotions, angry and anxious are examples of activating emotions, whereas disappointed and sad are examples of deactivating emotions. Both positive and negative activating moods and emotions should benefit performance via allocation of attentional resources to task demands (Baas, De Dreu, & Nijstad, 2008; De Dreu et al., 2008). On the other hand, both positive and negative deactivating moods and emotions should be detrimental to performance as they are associated with a lack of arousal, and consequently withdrawal from the task (Baas et al., 2008; De Dreu et al., 2008).

In support of this two-dimensional perspective, researchers have demonstrated that positive activating moods and emotions benefit performance, motivation, effort, and achievement, whereas positive deactivating moods and emotions have little to no benefit or even hinder these outcomes (Baas et al., 2008; De Dreu et al., 2008; Pekrun, Goetz, Daniels, Stupnisky, & Perry, 2010; Pekrun et al., 2002; To et al., 2012). A few studies have shown that negative activating moods can benefit performance via persistence (e.g., De Dreu et al., 2008; To et al., 2012). These same studies demonstrated that negative deactivating moods yielded little to no benefit or even hindered performance (De Dreu et al., 2008; To et al., 2012). However, these studies involving negative moods have exclusively examined tasks involving creative performance, in which domain-specific knowledge and time for idea generation and reflection are crucial (Baas et al., 2008; De Dreu et al., 2008; To et al., 2012).

Discrete Approach

Despite the popularity of categorizing affective experiences and discrete emotions based on underlying dimensions, some researchers argue that this approach may be overly simplistic as discrete emotions involve different appraisals (Ellsworth & Scherer, 2003; Lazarus & Cohen-Charash, 2001; Smith & Ellsworth, 1985). The notion is that discrete emotions can be differentiated from each other based on a number of underlying appraisal dimensions (i.e., pleasantness, responsibility/control, certainty, attention, effort, and situational-control; Smith & Ellsworth, 1985). Therefore, an individual's emotional experience depends on their appraisal of the situation, and the specific emotion experienced will differ depending on which combination of appraisal dimensions are tapped (Ellsworth & Scherer, 2003; Smith & Ellsworth, 1985). Accordingly, discrete emotions may have different underlying motivations, antecedents, and outcomes (Barsade & Gibson, 2007; Brief & Weiss, 2002; Ellsworth & Scherer, 2003; Gooty, Gavin, & Ashkanasy, 2009; Lazarus & Cohen-Charash, 2001).

These scholars argue that there is a loss of specificity in describing an individual's emotional experience when discrete emotions are subsumed under general dimensions (Barsade & Gibson, 2007; Brief & Weiss, 2002; Gooty et al., 2009). For example, from a dimensional approach, one might categorize several positive discrete emotions (i.e., happiness, pride) together and several negative discrete emotions together (i.e., anger, anxiety, frustration) based on their pleasantness. However, from a discrete approach, one might argue that although anger and frustration are both considered unpleasant, they are associated with different cognitive appraisals. For example, previous research has shown that anger is associated with high certainty (i.e., situation is predictable) and low situational-control (i.e., outcome attributed to situation), whereas frustration is associated low certainty and high situational-control (Smith & Ellsworth, 1985). Likewise, anger and fear are likely to have differing consequences. Anger is thought to stem from individuals perceiving they have been wronged, whereas fear is thought to stem from threat perceptions (Lazarus & Cohen-Charash, 2001). When an individual experiences anger, they may be motivated to approach a situation, whereas when an individual experiences fear, they may be motivated to avoid a situation (Ashton-James & Ashkanasy, 2008; Gooty et al., 2009). Consequently, by clustering discrete emotions together into general dimensions, it becomes difficult to differentiate emotions on the basis of the specific experience and outcomes (Gooty et al., 2009).

Although discrete emotions are likely to be important to performance, relatively little research has examined relationships between discrete emotions and performance (Lee & Allen, 2002; Levine et al., 2011; Shockley et al., 2012). In their meta-analysis of 98 studies, Shockley et al. (2012) found that with respect to negative emotions, *state anger* and *state sadness* were negatively related to performance, whereas *state anxiety* yielded a null effect. Additionally, *trait anxiety* and *trait frustration* were positively and negatively related to performance, respectively, while *trait anger* yielded a null effect (Shockley et al., 2012). These results suggest that negative discrete emotions may exhibit different relationships with performance. Unfortunately, only one positive discrete emotion (i.e., *happiness*) was included in the meta-analysis as it was the only positive emotion with enough data available. The results showed *state happiness* was positively related to performance (Shockley et al., 2012). However, it has been suggested that discrete emotions must provide incremental prediction over and above general dimensions of positive and negative affect to substantiate their viability as meaningfully unique constructs (Watson, 2000).

To our knowledge, only two studies—Lee and Allen (2002) and Levine et al. (2011)—have attempted to do this with behavioral outcomes. In general, their results supported the notion that discrete emotions provide incremental prediction. Specifically, Lee and Allen (2002) examined the incremental prediction by discrete emotions with respect to organizational citizenship behaviors (i.e., extra-role behaviors at work that may or may not be formally recognized by the organization; Organ, 1988; 1997) and workplace deviance (i.e., harmful behaviors that violate workplace norms; Robinson & Bennett, 1995). Lee and Allen (2002) examined the incremental prediction of 11 discrete emotions and found that only the negative emotions *fear*, *hostility*, *sadness*, and *guilt* provided incremental prediction over general affect in predicting organizational citizenship behaviors and workplace deviance. These results are consistent with literature showing that negative discrete emotions can be differentiated from each other (Keltner, Ellsworth, & Edwards, 1993; Raghunathan & Pham, 1999; Roseman, 1996; Smith & Ellsworth, 1985). The extant literature suggests mixed results for the differentiation of positive discrete emotions, with some finding it difficult to differentiate positive discrete emotions (Watson & Clark, 1991, 1992) and others finding that positive discrete emotions can be differentiated (Roseman, 1996; Smith & Ellsworth, 1985; Winslow, Hu, Kaplan, & Li, 2017).

In a similar vein, Levine et al. (2011) examined incremental prediction with respect to organizational citizenship behaviors, job satisfaction, and counterproductive work behaviors (i.e., harmful behaviors at work; Sackett, 2002; Spector & Fox, 2005) across American, Chinese, and Romanian samples. Although there were some notable differences in the results across the various samples, in general Levine et al.'s (2011) findings showed support for the incremental prediction of both positive and negative discrete emotions, but in contrast to the findings of Lee and Allen (2002) support for the incremental prediction of positive discrete emotions was more consistent than that for negative discrete emotions.

Taken together, the findings of Lee and Allen (2002) and Levine et al. (2011) suggest that discrete emotions may provide unique information above general dimensions and thus may be more informative than general dimensions alone. However, given the discrepancies between their results and how neither examined the incremental prediction of discrete emotions with respect to task performance or learning outcomes, it is difficult to make conclusions regarding how their results might inform emotion control strategies in the context of complex skill acquisition and adaptation. It is also important to note that neither examined differences as a function of activation potential. Simply put, the extant empirical literature provides little evidence-based guidance for how to support self-regulated learning, in terms of either skill acquisition or adaptation. In general, I expected some but not necessarily all discrete emotions to provide incremental prediction. With respect to whether positive or negative emotions would provide greater incremental prediction, the results from Lee and Allen (2002) and Levine et al. (2011) suggest opposing predictions with respect to positive emotions. Further, much of the research regarding emotion-performance relationships has tended to favor studying negative emotions (Shockley et al., 2012). Given the limited empirical research examining the incremental prediction of discrete emotions and the tendency to focus on negative emotions in the literature, I examined the following hypotheses and research question:

> *Hypothesis 1:* Discrete emotions will add incremental prediction over general valence dimensions of affect to the prediction of skilled performance.

> *Hypothesis 2:* Discrete emotions will exhibit variations in their incremental validities in predicting skilled performance.

> *Research Question 1:* Will evidence of incremental prediction be stronger for positive or negative discrete emotions?

Emotions play a crucial role in complex skill acquisition as they influence whether attentional resources are allocated towards or away from task demands (Kanfer & Ackerman, 1996). However, what is less clear in the literature is how emotions might influence performance following unforeseen changes in task demands. My search of the literature revealed no published studies that have investigated emotion-performance relationships during a period of adaptation. Indeed, recent reviews of the empirical literature on adaptive performance have lamented the lack of empirical attention given to the psychological processes underlying adaptive performance (Baard et al., 2014), especially in regard to emotions and affective self-regulatory variables (Jundt, Shoss, & Huang, 2015). Rather, the empirical literature is limited to studies of how emotion control during acquisition is linked to performance occurring later after a change in task demands (e.g., Bell & Kozlowski, 2008; Keith & Frese, 2005; Niessen & Jimmieson, 2016). Emotions are likely to be important in adaptation for similar reasons as in skill acquisition; however in adaptation individuals need to allocate attentional resources to making sense of new task demands in relation to unlearning old strategies, modifying existing strategies, and developing new strategies. Thus, it is possible that certain discrete emotions could provide greater incremental prediction in adaptation because of the inherent difficulty associated with learning new strategies and unlearning old habits in adaptation compared to acquisition. Given the limited empirical research, I examined the following research question:

> *Research Question 2:* Will evidence of incremental prediction be different in adaptation versus acquisition?

STUDY 1

Method

Participants. Data from two similar protocols were combined into one dataset (i.e., Huck et al., 2019; Jorgensen et al., under review). Five hundred twenty undergraduate students from the Department of Psychology's participant pool at the University of Oklahoma participated in exchange for research credit in a psychology course. Data from 53 participants were removed from analyses due to incomplete data stemming from technical difficulties (n = 24), flatlining on performance measures (n = 4), not following instructions (n = 8), or responding carelessly on measures (*n* = 17), resulting in a final sample of 467 participants (293 males, 174 females). Participants ranged in age from 17 to 32 years (*M* = 19.09, *SD* = 1.62).

Performance Task. The experimental task was Unreal Tournament 2004 (UT2004; Epic Games, 2004), a commercially available first-person shooter computer game that has been used in previous research on complex skill acquisition (e.g., Hardy, Day, Hughes, Wang, & Schuelke, 2014; Hughes et al., 2013). The objective of the task was to destroy computer-controlled opponents while minimizing the destruction of one's own character. Participants could collect new weapons or resources (i.e., power-ups) during each trial to increase their character's health or offensive and defensive capabilities. When a participant's character or opponent was destroyed, it reappeared in a random location with the default weapons and capabilities. The game was "every character for him- or herself," meaning that the computer-controlled characters were in competition with each other as well as the participant. UT2004 is a fast-paced, dynamic task involving cognitive and perceptual-motor demands. Participants used a mouse and keyboard simultaneously to move and control their character, all the while learning the strengths and weaknesses of different weapons and strategies, and quickly deciding which to use given the current situation.

Procedure. Individuals participated in cohorts of no more than seven and were told that the purpose of the present study was to investigate how people learn to play a dynamic and complex videogame. They first completed an informed consent form followed by a demographics questionnaire. Participants were told that they would be entered into a lottery to win one of five $25 gift cards for each trial in which their score was in the top 50% of all study participants for that given trial. Participants watched a 15-minute training presentation on UT2004 explaining the basic game controls, rules, and power-ups, followed by a 1-minute practice trial to gain familiarity with the controls, display, and game environment without facing any opponents.

Participants then completed 14 sessions each consisting of two 4-minute trials. Following each session, participants completed a state-based self-report measure of emotions. For the first seven sessions, participants competed against two computer-controlled opponents at a difficulty setting of 4 (on a 1-to-8 scale). Following the seventh session (i.e., the midway point; 14th pre-change trial), several key elements of the task were changed without warning, which increased its complexity (Hughes et al., 2013). Players competed against nine computer-controlled opponents at a difficulty setting of 5. In addition, the game environment (i.e., map) was much larger, with wider spaces, multiple levels of platforms, and edges over which characters could fall to their destruction. The game characteristics for the pre- and post-change trials were the same as those used by Hardy et al. (2014) to measure analogical and adaptive transfer performance, respectively. Participants were debriefed following the 14th session (i.e., 28th post-change trial).

Measures. A variety of existing scales were used to measure the concepts of interest.

Task Performance. Task performance scores for each trial were calculated using the same index as Hardy et al. (2014): player kills (i.e., number of times a participant destroyed an opponent) divided by the quantity of kills plus deaths (i.e., number of kills plus the number of times a participant's own character was destroyed) plus player rank (i.e., the participant's rank relative to the computer opponents in that trial). For ease in interpretability, performance scores were then multiplied by 100. Performance for each session was calculated by taking the average of the trial scores.

Emotions. State emotions were measured using an adapted version of the Positive Affect

Negative Affect Scale (PANAS; Watson, Clark, & Telegan, 1988) that was used in previous research (Baas et al., 2008; De Dreu et al., 2008; To et al., 2012). It included adjectives that were especially relevant to the performance context of the present study (see Figure 2). Items asked participants to rate the extent to which they experienced the emotion during the previous two trials. For all items, participants responded using a 9-point Likert scale (1 = *very slight/not at all*, 9 = *extremely*). Positive discrete emotions included *enthusiastic*, *happy*, *excited*, *calm*, *relaxed*, and *at ease*. Negative discrete emotions included *angry*, *anxious*, *frustrated*, *irritated*, *tense*, *uneasy*, *bored*, *disappointed*, *discouraged*, and *fatigued*. Positive affect for each session was calculated by taking the average of all positive discrete emotions at that session. Negative affect for each session was calculated by taking the average of all negative discrete emotions at that session. Mean coefficient alphas across the 14 sessions was 0.84 (*min* = 0.83, *max* = 0.86) and 0.89 (*min* = 0.86, *max* = 0.90) for positive and negative affect, respectively.

Covariate measures. Self-reported ACT scores ($M = 26.86$, $SD = 4.17$) were used as an index of general mental ability (GMA). A 4-item scale was used to measure prior videogame experience, which served as a proxy for pre-training videogame knowledge. For the first two items, participants responded using a 5-point Likert scale (1 = *not at all*, 2 = *rarely, just a few times*, 3 = *monthly*, 4 = *weekly*, 5 = *daily*) to the following questions: (a) "*Over the last 12 months, how frequently have you typically played video/computer games?*" ($M = 2.94$, $SD = 1.41$) and (b) "*Over the last 12 months, how frequently have you typically played first-person shooter video/computer games (e.g., Call of Duty, Half-Life, Halo, Unreal Tournament)?*" ($M = 2.30$, $SD = 1.29$). For the second two items, participants indicated how many hours per week they typically played video/computer games ($M = 4.48$, $SD = 6.75$, min. = 0.00, max. = 50.00) and more specifically, first-person shooter video/computer games ($M = 1.87$, $SD = 3.89$, min. =

0.00, max. = 30.00). Scores for these four items were standardized and then averaged to create a composite score ($\alpha = 0.70$).

Results

Tables 1 and 2 display descriptive statistics and correlations for positive and negative emotions, respectively. Figure 3 displays the means for discrete emotions and performance scores across sessions. In general, positive discrete emotions tended to decrease over time with little discontinuity following the change in task demands. Negative discrete emotions tended to fluctuate more than positive emotions but generally decreased over time, except for *bored* and *fatigued* which tended to increase over time. However, there was a sharp increase following the task change for all the negative emotions, except *bored*, which decreased.

For positive discrete emotions, there was a sharp increase in emotions on the last session. Upon further exploration, it appeared that some participants rated the emotions at a very low level on the second-to-last session but switched to the opposite end of the scale on the last session. Emotions in the last session ostensibly appeared to be associated with finishing the study rather than performance. Therefore, I dropped scores from the last session when testing the hypotheses and research questions.

The performance trends were similar to those found in studies using a comparable design (e.g., Lang & Bliese, 2009). As shown in Figure 3, discontinuity was observed between pre-change and post-change sessions for performance. Consistent with a classic skill-acquisition curve (Fitts & Posner, 1967), performance increased and gradually plateaued over the course of pre-change sessions. Then, performance sharply declined following the task change. During the post-change sessions, performance steadily increased, however, and similar to previous studies involving a task-change paradigm (e.g., Lang, & Bliese, 2009), gains in performance were smaller in post-change compared to pre-change sessions.

Modeling Building Process. Discontinuous mixed-effects growth models were used to estimate performance during skill acquisition (SA), transition adaptation (TA), and reacquisition adaptation (RA). Table 3 displays the coding scheme used for the growth components (Bliese & Lang, 2016). Skill acquisition refers to the linear rate of acquisition (i.e., performance change) in the pre-change period. Transition adaptation reflects the expected drop in performance following the task change. It is interpreted as the difference in performance relative to the expected value had the task change not happened. Reacquisition adaptation reflects the rate of performance change following the task change relative to the linear rate of performance change prior to the task change. Quadratic trends for skill acquisition and reacquisition adaptation were also estimated to account for curvilinear change in the pre- and post-change periods (Lang & Bliese, 2009). Models were corrected for autocorrelation and estimated using the nlme package in R (Pinheiro, Bates, DebRoy, & Sarkar, 2016; R Development Core Team, 2016).

To determine if positive and negative discrete emotions provided incremental prediction over and above positive and negative affect, I used a similar process as Levine et al. (2011). Incremental prediction was determined by examining the effect for each discrete emotion after controlling for effect of the general dimension without including specific discrete emotion. For example, the incremental prediction by *happy* was examined over the sum of all other positive discrete emotions (i.e., *enthusiastic, excited, at ease, calm*, *relaxed*), and likewise the incremental prediction by *calm* was examined over the sum of all other positive discrete emotions (i.e., *enthusiastic, excited, happy, at ease, relaxed).* The incremental prediction by *angry* was examined over the sum of all other negative discrete emotions (i.e., *anxious, bored,* *disappointed, discouraged, fatigued, frustrated, irritated, tense, uneasy*), and likewise the incremental prediction by *discouraged* was examined over the sum of all other negative discrete emotions (i.e., *angry, anxious, bored, disappointed, fatigued, frustrated, irritated, tense, uneasy*).

Separate models were conducted for each discrete emotion for a total of 16 analyses (see Table 4 for the model building sequence used for each model). Following Bliese and Lang (2016), I tested a series of models starting with the basic growth model. In Step 1, I tested the effects for each growth variable included in the equation below (see Model 1; Table 5):

$$Y_{ij} = \gamma_{00} + \gamma_{10}\text{Skill acquisition} + \gamma_{20}\text{Transition adaptation} + \gamma_{30}\text{Reacquistion adaptation} + \gamma_{40}\text{Quadratic skill acquisition} + \gamma_{50}\text{Quadratic reacquisition adaptation} + \varepsilon_{ij}$$

Results showed a significant rate of skill acquisition (B = 5.36, p < .01), a negative transition adaptation (B = –18.63, p < .01), and a significantly lower rate of reacquisition adaptation (B = –4.41, p < .01). The quadratic trend for skill acquisition was also significant (B = –0.55=, p < .01), indicating increases in performance decelerated across pre–change sessions. However, the quadratic trend for reacquisition adaptation was not significant; thus it was removed in subsequent models.

In Step 2, I added the covariates (i.e., sex, general mental ability, and videogame experience; see Model 2; Table 5 for results). ACT and videogame experience were grand-mean centered. The main effects of ACT (B = 0.69, p < .01) and videogame experience (B = 5.94, p < .01) on performance were positive and significant. Prior videogame experience and higher ACT scores were associated with higher performance scores. Additionally, the main effect of sex on performance was negative and significant (B = –14.76, p < .01), reflecting that females exhibited lower levels of performance than males.

I examined emotion-performance relationships at both the between- and within-person levels of analysis to determine if relationships were similar across levels. Between-person analyses speak to the average emotions experienced during the period of performance, whereas within-person analyses speak to the fluctuations in emotions experienced during the period of performance. For example, when averaging the anger an individual experienced across the performance period, one might find that the individual generally experienced a low level of anger. However, the same individual could experience upward or downward spikes in anger at any point during the same performance period. Accordingly, between- and within-person analyses allow for both the overall averages and momentary fluctuations to be captured. Results for Steps 3-6 will be reviewed in the following sections. In Step 3, I added the general dimension of positive or negative affect, depending on which discrete emotion I was examining, at both the between- and within-person levels of analysis. In Step 4, I added the discrete emotion at the between- and within-person levels of analysis. Next, in Step 5, I examined interactions between the growth variables and the general dimensions at both levels of analysis. Last, in Step 6, I examined interactions between the growth variables and discrete emotions at both levels of analysis.

General Dimensions. Results for Step 3 are not displayed in tables as between-person (BP) and within-person effects (WP) were similar and statistically significant in all analyses (all *p*s < .01). Positive affect was associated with higher performance scores (BP: $B_{\text{mean}} = 2.10$; WP: $B_{\text{mean}} = 2.21$), whereas negative affect was associated with lower performance scores (BP: $B_{\text{mean}} = -2.33$; WP: $B_{\text{mean}} = -2.44$).

Regarding Step 5, the results showed improved fit for all 16 models. The results for the positive discrete emotions showed a statistically significant negative interaction including transition adaptation and the between-person general dimension (B_{mean} = –1.57). No other interactions including the general positive dimension, whether between- or within-persons, was statistically significant. The results for the negative discrete emotions showed a statistically significant positive interaction including transition adaptation and the between-person general dimension (B_{mean} = 2.09). The skill acquisition and reacquisition adaptation interactions with the general negative dimension at the between-person level were not statistically significant. At the within-person level, the results showed negative skill acquisition interactions (B_{mean} = –0.23), and positive transition adaptation (B_{mean} = 1.81) and reacquisition adaptation (B_{mean} = 0.32) interactions. In general, the results showed that emotion relationships were weaker in adaptation compared to acquisition.

Tests of Hypotheses and Research Questions.

Hypothesis 1. Hypothesis 1 predicted that discrete emotions would provide incremental prediction over the general dimensions of affect to the prediction of skilled performance. For positive activating emotions, results at both levels of analysis were consistent and indicated that all positive activating emotions provided incremental prediction (see Model 4; Table 6): *enthusiastic* (BP: B = 1.76, $p < .01$; WP: B = 0.72, $p < .01$), *excited* (BP: B = 1.56, $p < .01$; WP: B = 0.85, $p < .01$), and *happy* (BP: B = 1.99, $p < .01$; WP: B = 0.80, $p < .01$).

Results for positive deactivating emotions were less consistent across levels of analysis (see Model 4; Table 6). At the between-person level of analysis, results indicated that all positive deactivating emotions provided incremental prediction: *at ease* (B = –0.92, $p < .05$), *calm* (B = –1.25, $p < .01$), and *relaxed* (B = –0.81, $p < .05$). However, at the within-person level of analysis, only *at ease* (B = 0.21, $p < .05$) provided incremental prediction. Interestingly, the between-person effects for all positive deactivating emotions were negative compared to their positive zero-order correlations. Given the findings, Hypothesis 1 was supported for positive activating emotions and received mixed support for positive deactivating emotions.

For negative activating emotions, the results at the between- and within-person levels of analysis were not always consistent (see Model 4; Table 7). At the between-person level of analysis, *angry* (B = 0.83, p < .05), *anxious* (B = 0.95, p < .01), and *tense* (B = 1.63, p < .01) provided incremental prediction. Interestingly, the between-person effects for *angry*, *anxious*, and *tense* were all positive compared to their negative zero-order correlations. In contrast, at the within-person level, all negative activating emotions except for *uneasy* provided incremental prediction (see Model 4; Table 7): *angry* (B = –0.65, p < .01), *anxious* (B = 0.24, p < .01), *frustrated* (B = –0.69, p < .01), *irritated* (B = –0.52, p < .01), and *tense* (B = 0.29, p < .01). It is important to note that the effects for *anxious* and *tense* were positive compared to their negative zero-order correlations. For negative activating emotions, all significant effects at the between-person level were positive. However, at the within-person level, the direction of effects varied across specific emotions.

Results for negative deactivating emotions showed more consistency, but primarily at the within-person level (see Model 4; Table 7). At the between-person level of analysis, of the negative deactivating emotions only *bored* (B = –1.31, p < .01) provided incremental prediction. At the within-person level of analysis, all negative deactivating emotions provided incremental prediction (see Model 4; Table 7): *bored* (B = –0.43, p < .01), *disappointed* (B = 0.37, p < .01), *discouraged* (B = –0.42, p < .01), and *fatigued* (B = –0.15, p < .05). However, it is important to note that effects at the within-person and between-person levels of analysis were all negative. Overall, Hypothesis 1 received mixed support for negative activating and negative deactivating emotions.

Hypothesis 2. Hypothesis 2 predicted that discrete emotions would exhibit variation in incremental validities in predicting skilled performance. Although there was no variation among positive activating emotions with all effects statistically significant and in the same direction as their zero-order correlations, the results showed that not all positive deactivating, negative activating, and negative deactivating effects were statistically significant and that some of the statistically significant effects were in a direction opposite their respective zero-order correlations. Also, the effect sizes for the positive deactivating emotions were smaller than the effect sizes for the positive activating emotions. Thus, Hypothesis 2 was supported. There was variation in the incremental prediction across the different discrete emotions, although not among the positive activating emotions.

Research Question 1. Research Question 1 asked whether evidence of incremental prediction would be stronger for positive or negative emotions. Across 12 tests of incremental prediction for positive emotions (6 discrete emotions × 2 levels of analysis), 10 (83%) were statistically significant. Across 20 tests of incremental prediction for negative emotions (10 discrete emotions × 2 levels of analysis), 13 (65%) were statistically significant. These results suggest the evidence of incremental prediction was slightly stronger for positive emotions. Also, it is important to again acknowledge that only positive activating emotions yielded effects that were all statistically significant and in the same direction as their respective zero-order correlations (positive). Thus, the evidence of incremental prediction was strongest for positive activating emotions.

Research Question 2. Research Question 2 asked whether evidence of incremental prediction would be different in adaptation versus acquisition. In Step 6, I added the interactions between discrete emotions and the growth variables: skill acquisition, transition adaptation, and reacquisition adaptation. Improved fit for this step with statistically significant interactions for either or both transition and reacquisition adaptation would indicate meaningful differences between adaptation and acquisition. Across all discrete emotions, there was poorer fit for this step with growth interactions. Given the nil effects, the results showed that incremental prediction did not differ between adaptation and acquisition performance.

Supplementary analyses. As an additional step, I conducted hierarchical regression analyses using a similar model building process as the one described earlier. However, for these supplementary analyses, I used Session 7 (pre-change) and Session 14 (post-change) performance as my outcome variables. In Step 1, I included my covariates (i.e., sex, ACT scores, and videogame experience). Next, in Step 2, I included the average positive or negative affect across Sessions 1-6 (pre-change) or Sessions 8-13 (post-change). Last, in Step 3, I included the average discrete emotion scores across Sessions 1-6 (pre-change) or Sessions 8-13 (post-change). The results for pre-change and post-change scores are shown in Appendices A and B, respectively. In general, the results from these analyses were consistent with the ones presented in the preceding sections.

Discussion

Study 1 extends the existing empirical literature by examining if there is any benefit to studying emotions at the discrete level rather than just focusing on general dimensions of affect in complex skill learning. In general, there was evidence for the incremental prediction by both positive and negative discrete emotions at the between- and within-person levels of analysis but the results also showed meaningful variation as a function of valence and activation potential.

Consistent with Lee and Allen (2002) and Levine et al. (2011), the results speak to the viability of studying emotions at the discrete level. However, this study was an important extension of previous research by examining incremental prediction with respect to task performance, which has been conspicuously unstudied. In general, evidence for incremental prediction was consistently strong for positive activating emotions at both levels of analysis compared to positive deactivating emotions. Evidence for the incremental prediction by negative deactivating emotions was also consistent at the within-person level of analysis but varied at the between-person level. There were no clear trends for negative activating emotions. In general, the pattern of effects was clearest and most consistent for positive activating emotions. Overall, the results of Study 1 show broad dimensions can be helpful for studying emotions as they relate to performance, but they do not always adequately capture nuances to emotion-performance relationships. There were many circumstances in which examining the dimension or combination of dimensions was not enough to determine when an emotion would provide incremental prediction. Rather, incremental prediction varied for emotions and suggests there is often something about specific emotions that makes them meaningfully distinct from broader dimensions.

Contrary to Levine et al. (2011), but consistent with Lee and Allen (2002), I observed a reversal of relationships for all of the positive deactivating emotions (i.e., *at ease*, *calm*, *relaxed*) at the between-person level of analysis and for several of the negative activating emotions (i.e., *anxious* and *tense*) at both levels of analysis. These findings lend support to the dual pathway model, which suggests activating emotions will benefit performance because they lead to on-task attention via arousal, whereas deactivating emotions will do the opposite (Baas et al., 2008; De Dreu et al., 2008). Thus, the results suggest that, apart from their shared variance with other similarly valenced emotions, feeling *anxious* and *tense* may benefit learning and performance, whereas feeling *at ease, calm,* or *relaxed* may inhibit learning and performance.

Although incremental prediction was clearest and most consistent for positive activating emotions, the nature of the performance context should be considered when interpreting the findings. Aspects of these findings may be specific to complex, fast-paced performance domains with strong cognitive and perceptual motor demands (e.g., eSports, aviation, virtual training and synthetic learning environments). Further, characteristics of the present study may have created a context that magnified the distracting influence of positive activating emotions (i.e., *at ease*, *calm*, or *relaxed*) emotions, while simultaneously amplifying the benefit of experiencing negative emotions (i.e., *anxious*, *tense*). Additionally, the discrete emotions were assessed using single-item, self-report measures, which means internal-consistency reliability and construct representativeness cannot be assessed. Nevertheless, these findings may inform future research that seeks to examine emotion regulation in the context of complex skill learning.

Additionally, the current study extends the literature by investigating differences in the evidence for incremental prediction provided in adaptation compared to acquisition at both levels of analysis. Fit indices indicated that the step including interactions between the growth variables and discrete emotions provided poorer fit compared to the previous step. As such, results indicated that the evidence for incremental prediction did not differ between acquisition and adaptation for positive and negative discrete emotions. Minding the limitations of the sample and context, my results have implications for emotion control during skilled performance and learning, which is the primary focus of Study 2.

STUDY 2

While previous research has measured emotion control or incorporated emotion control strategies (Bell & Kozlowski, 2008; Kanfer & Ackerman, 1996; Keith & Frese, 2005; Niessen & Jimmieson, 2016), it can be difficult to determine which aspects of emotion control are beneficial to performance. For example, prior research that has measured emotion control has primarily focused on the regulation of negative emotions while learning a task (Keith & Frese, 2005; Niessen & Jimmieson, 2016). Items on these scales pertain to whether the participant was able to keep calm or focus on the task despite experiencing negative emotions. As the focus of these scales is primarily on reducing negative emotions, they do not speak to whether experiencing positive emotions may benefit performance. Furthermore, results from previous studies incorporating emotion control strategies are difficult to disentangle as they often include both positive and negative emotions or attitudes. For example, in the two studies mentioned previously (i.e., Bell & Kozlowski, 2008; Kanfer & Ackerman, 1996), participants were instructed to decrease negative thoughts and increase positive thoughts or to replace negative thoughts with positive thoughts. In doing so, it is difficult to know if they may have reduced the positive effects of certain negative emotions that may be beneficial to performance (i.e., tense) or if prompting individuals to keep a positive attitude may have prompted them to experience certain positive emotions that may be detrimental to performance (i.e., calm). Thus, the contribution of Study 2 was to target specific positive emotions in an emotion control manipulation with the intention of determining which elements of emotion control benefit learners across periods of acquisition and adaptation.

The results from Study 1 imply that emotion control manipulations may be more effective when targeting discrete emotions compared to focusing on general positive or negative feelings. Although previous research has suggested that positive moods (affect) and emotions should benefit performance (Beal et al., 2005; Cacioppo et al., 1999; Carver & Scheier, 1998; Fredrickson & Branigan, 2005; Seo et al., 2004), the results of Study 1 suggest that emotion-performance relationships may be driven, in part, by activation potential. Specifically, I found clear, consistently positive effects for positive activating emotions at both the within- and between-person levels of analysis. In contrast, effects for positive deactivating emotions were often weaker or non-significant and varied in direction depending on the level of analysis, consistent with dual pathway theory in most cases (Baas et al., 2008; De Dreu et al., 2008). With respect to developing an emotion control manipulation that is specific to my context, given the differences between positive activating and deactivating emotions, I compared two emotion control strategies: one targeting positive activating emotions and one targeting positive deactivating emotions. I am unaware of research that has compared the effectiveness of emphasizing positive activating emotions compared to emphasizing positive deactivating emotions in the context of complex skill learning. Accordingly, I examined the following hypotheses:

> *Hypothesis 3*: An emotion control strategy that targets positive activating emotions will yield better performance than no strategy as well as a strategy that targets positive deactivating emotions.

> *Hypothesis 4*: An emotion control strategy that targets positive deactivating emotions will yield worse performance than no strategy.

In particular, I expected that the emotion control conditions would lead to an increase in corresponding emotions experienced by participants. In turn, these emotions experienced would influence performance. Thus, the relationship between the emotion control conditions and performance would be mediated by the emotions experienced. Accordingly, I examined the following hypotheses:

> *Hypothesis 5*: An emotion control strategy that targets positive activating emotions will yield higher levels of positive activating emotions than no strategy as well as a strategy that targets positive deactivating emotions.

> *Hypothesis 6*: An emotion control strategy that targets positive deactivating emotions will yield higher levels of positive deactivating emotions than no strategy as well as a strategy that targets positive activating emotions.

Hypothesis 7: Positive activating emotions will be positively related to performance controlling for positive deactivating emotions.

Hypothesis 8: Positive deactivating emotions will be negatively related to performance controlling for positive activating emotions.

Hypothesis 9: Positive activating emotions will mediate the beneficial effects of positive activating emotion control on performance.

Hypothesis 10: Positive deactivating emotions will mediate the harmful effects of positive deactivating emotion control on performance.

To further understand emotion-performance relationships, I conducted a qualitative analysis of participants responses to several open-ended questions related to emotion control to explore differences and similarities in the perceived usefulness between positive activating and positive deactivating emotions in the context of complex skill learning. Accordingly, I examined the following research questions:

Research Question 3: What are the similarities in the perceived usefulness between positive activating and positive deactivating emotions?

Research Question 4: What are the differences in the perceived usefulness between positive activating and positive deactivating emotions?

Method

Participants. Sixty-one undergraduate males students from the Department of Psychology's participant pool at the University of Oklahoma participated in exchange for course credit. Given the circumstances surrounding COVID-19, all in-person data collection was halted before I could collect data on the number of participants originally planned. As such, the sample size for Study 2 was relatively small. Only males were used for the present study as previous research has shown that there are gender differences with respect to enjoyment and performance in first-person shooter video games (Hopp & Fisher, 2017) as well as likelihood of playing these games (Hartmann & Klimmt, 2006). Data from seven participants were removed from analyses due to incomplete data, resulting in a final sample of 54 participants (18 in each condition). Participants ranged in age from 18 to 26 (*M* = 19.19, *SD* = 1.30)

Performance Task. As in Study 1, the experimental task used in this study was Unreal Tournament 2004 (UT2004; Epic Games, 2004).

Procedure. The procedures in Study 2 were similar to Study 1 and can be found in Appendix C. Like Study 1, participants completed a total of 14 sessions, each consisting of two 4-minute trials (i.e., 28 trials). Prior to the first session, participants underwent the start to their respective emotion-control strategy manipulation. Following each session, participants completed state-based self-report measures of emotions as well as a few other measures not germane to the study's hypotheses and research questions. They were also given brief emotion-control reminders consistent with their respective condition. After the seventh session, participants were presented with questions asking them about their reactions towards their respective emotion control strategy and reminders. The first seven sessions and the final seven sessions served as acquisition (i.e., pre-change) and adaptation (i.e., post-change), respectively, with the exact same settings as Study 1 except for difficulty. The difficulty was increased one level as this is what previous research using Unreal Tournament has used for an all-male sample (Hardy et al., 2014).

Emotion control conditions. Participants were randomly assigned to one of three conditions: positive activating emotion control (i.e., excited, enthusiastic, happy), positive deactivating emotion control (i.e., calm, relaxed, at ease), or no emotion control condition. Prior to starting their first session, participants in the emotion control conditions were given a prompt that asked them to reflect on a time that they felt the emotions listed specific to their conditions and to think about how these emotions might be applied to learning Unreal Tournament; the emotions in the positive activating emotion control condition were *excited*, *enthusiastic*, *happy* and the emotions in the positive deactivating emotion control were *calm*, *relaxed*, *at ease*. The purpose of this prompt was to encourage participants to think about how emotions have influenced prior learning experiences and to help them develop their own strategies for managing their emotions while learning UT2004. After reflecting on their experiences, they were asked to respond to four open-ended questions asking them about the experience they reflected on and how emotions played a role in their particular experience. Then, they were asked how these emotions can be useful while playing Unreal Tournament and how they can keep feeling these specific emotions while engaging with the task. Appendices D and E show the prompts and questions for positive activating and positive deactivating conditions, respectively. Between sessions, reminders appeared on the screen after the self-report measures reminding participants how feeling either *excited*, *enthusiastic*, and *happy* or *calm*, *relaxed*, and *at ease* can be helpful (Appendix F shows the reminders for both conditions). Participants in the no emotion control condition did not receive any condition-specific prompts or open-ended questions.

Given previous research has not prompted individuals to reflect on specific positive emotions, this exploratory study is necessary to determine if the developed strategy targeting positive activating emotions is sensible and helpful to participants, and likewise if the strategy targeting positive deactivating emotions is impractical and distracting to participants. Thus, following the seventh session, participants were asked to provide feedback regarding the manipulations and reminders via Likert scales and open-ended questions.

Measures. A variety of existing scales were used to measure the concepts of interest. In addition, a number of new scales were developed.

***Task Performance*.** Task performance scores were calculated the same as in Study 1.

Emotions. State emotions were measured the same way as in Study 1. Positive activating emotions included *enthusiastic*, *happy*, *excited* and positive deactivating emotions included *calm*, *relaxed*, and *at ease*. Mean coefficient alphas across the 14 sessions were 0.84 (min. = 0.75, max. = 0.93) and 0.85 (min. = 0.75, max. = 0.93) for positive activating and positive deactivating emotions, respectively.

Formative evaluation feedback and reactions. Participants affective (i.e., satisfaction, enjoyment) and utility (i.e., usefulness) reactions towards the training as well as their respective emotion-control strategy manipulation and reminders were assessed using Likert scales. Affective reactions towards the manipulation and reminders were measured using two items. Participants responded on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*) to the following statements: "I liked the prompt and responding to the open-ended questions at the beginning of the study asking me to reflect on my emotions" and "I liked the reminders that appeared after every two games asking me to reflect on emotion strategies".

Utility reactions towards the manipulation and reminders were measured using two items. Participants responded on a 5-point Likert scale (1 = *not at all helpful* to 5 = *extremely helpful*) to the following questions: "To what extent were the prompt and questions helpful?" and "To what extent were the reminders in between games helpful?"

Covariates. ACT scores and videogame experience served as covariates and were measured the same way as in Study 1. For the first two videogame experience items, participants responded to the following questions: (a) "*Over the last 12 months, how frequently have you typically played video/computer games?*" (*M* = 3.26, *SD* = 1.23) and (b) "*Over the last 12 months, how frequently have you typically played first-person shooter video/computer games (e.g., Call of Duty, Half-Life, Halo, Unreal Tournament)?*" (*M* = 2.65, *SD* = 1.12). For the second two items, participants indicated how many hours per week they typically played video/computer games (*M* = 5.29, *SD* = 6.03, min. = 0.00, max. = 30.00) and more specifically, first-person shooter video/computer games (*M* = 2.54, *SD* = 4.47, min. = 0.00, max. = 30.00). Scores for the four items measuring videogame experience were standardized and then averaged to create a composite score (α = .73).

Open-ended questions. As mentioned previously, participants in the positive activating and positive deactivating emotion control conditions were asked to respond to several open-ended questions before they began playing the game (see Appendices B and C). Additionally, they were asked to provide formative feedback about both the prompts and reminders associated with their conditions via open-ended questions halfway through their participation. After responding to the Likert-scale, formative-evaluation questions, participants were presented with two open-ended questions. The open-ended questions were "If you think they were helpful in any way, please describe how they were helpful" and "If you think they were harmful in any way, please describe how they were harmful." Similarities and differences between the emotion control groups in their responses to the open-ended questions were coded to help examine what similarities and differences exist in the perceived usefulness of positive activating and positive deactivating emotions for complex skill learning. A detailed description of the qualitative coding process is provided in the section discussing the qualitative analyses and results.

Quantitative Analyses and Results

Table 8 displays the descriptive statistics and correlations for positive emotions and performance. Prior to examining analyses pertaining to my hypotheses or research questions, I conducted a one-way analysis of variance (ANOVA) to examine whether participants in the emotion control conditions differed on covariates that could influence learning or performance outcomes. The one-way ANOVA indicated that neither ACT scores ($F(2,51) = 1.02$, $p = .37$) nor videogame experience ($F(2,51) = 1.74$, $p = .18$) significantly differed by condition. Nevertheless, these covariates were still included in hypothesis testing given previous research has shown that they are robust predictors of performance across a variety of contexts (e.g., Beier & Oswald, 2012; Lang & Bliese, 2009).

The performance trends were similar to those found in studies using a comparable design (e.g., Lang & Bliese, 2009). As shown in Figure 4, session performance increased and gradually plateaued over the course of pre-change sessions, then declined following the task change and gradually increased across post-change sessions. However, gains in performance were smaller in post-change compared to pre-change sessions. Before testing the hypotheses and to get an overview of the effects for performance, I conducted a 3 (condition: positive activating, positive deactivating, control) by 14 (session) mixed analysis of covariance (ANCOVA) controlling for ACT scores and videogame experience. Figure 5 shows the adjusted mean performance scores. In general, and in sharp contrast to what was hypothesized, performance scores were higher in the positive deactivating condition across pre-change and post-change sessions compared to in the positive activating and no emotion control conditions. The differences between the conditions appeared larger in post-change sessions as performance scores for those in the positive deactivating condition continued to increase over time at a larger rate. There was little difference between those in the positive deactivating and no emotion control condition across pre-change and post-change sessions. Thus, contrary to expectations, the ANCOVA results suggested a single dummy-coded variable should be used in model building to compare those in the positive deactivating condition to those in the positive activating and no emotion control conditions.

Similarly, to get an overview of the emotion trends by condition, I conducted 3 (condition: positive activating, positive deactivating, control) by 14 (session) mixed ANCOVAs for positive activating and positive deactivating emotions separately. However, these ANCOVAs showed that neither ACT scores nor videogame experience were significant covariates. Therefore, I simply plotted the raw means for the emotion scores. Specifically, Figures 6 and 7 display the mean emotion scores for positive activating and positive deactivating emotions, respectively. As shown in Figure 6, in general, positive activating emotions tended to decrease over time. Scores in the positive deactivating condition tended to have higher positive activating scores in the first four sessions, but then their scores declined and the positive activating condition had higher scores across the rest of the pre-change and post-change sessions. Those in the no emotion control condition had the lowest positive activating scores across all of the pre-change and most of post-change sessions, with the exception of the last three sessions of post-change. As shown in Figure 7, trends for positive deactivating emotions showed a general increase in scores across sessions with overall higher scores in the no emotion control condition. In general, the emotion scores did not reflect differences by condition as hypothesized.

Model Building Process. Discontinuous growth models were used to examine condition differences in performance and emotion scores during skill acquisition, transition adaptation, and reacquisition adaptation using the same coding scheme of change variables used in Study 1 (see Table 3). Emotions, ACT scores, and videogame experience were all grand-mean centered.

Tests of Hypotheses.

Condition Effects on Performance: Hypotheses 3 and 4. Similar to analyses in Study 1, I tested a series of models starting with the basic growth model and performance as the outcome variable (see Table 9 for the model building sequence). In Step 1, I tested the effects for each growth variable (see Model 1; Table 10). Results showed a significant rate of skill acquisition ($B = 3.76$, $p < .01$), a negative transition adaptation ($B = –15.80$, $p < .01$), and a significantly lower rate of reacquisition adaptation (*B* = –2.57, $p < .01$). The quadratic trend for skill acquisition was also significant (*B* = –0.36, $p < .01$), indicating increases in performance decelerated across pre-change sessions. However, the quadratic trend for reacquisition adaptation was not significant, thus it was removed in subsequent models. In Step 2, I added the covariates (see Model 2; Table 10). Similar to Study 1, the main effects of ACT (*B* = 0.80, $p < .05$) and videogame experience (*B* = 3.87, $p < .05$) on performance were positive and significant. Prior videogame experience and higher ACT scores were associated with higher performance scores.

Although Hypothesis 3 predicted that an emotion control strategy targeting positive activating emotions would yield better performance than no strategy as well as a strategy that targets positive deactivating emotions, the results of the ANCOVA suggested that this hypothesis was not supported as the adjusted means for performance were higher for the positive deactivating condition compared to the other conditions. Similarly, the results of the ANCOVA did not support Hypothesis 4 which predicted that an emotion control strategy targeting positive deactivating emotions would yield worse performance than no strategy, as the adjusted means between those in the positive activating condition were similar to those in the no emotion control condition. Nevertheless, the adjusted means from the ANCOVA suggested the positive deactivating condition should be compared to the other two conditions given the separation in performance scores. Accordingly, in Step 3 I added a dummy-coded condition variable in the model to compare the positive deactivating condition to the other conditions (i.e., see Model 3, Table 11): positive deactivating emotional control = 1, positive activating emotion control = –0.5, and no emotion control = –0.5. The results showed that the dummy-coded condition variable was positive and significant (*B* = 3.44, $p < .05$), indicating that performance scores were higher for those in the positive deactivating condition compared to the other conditions. In Steps 4 and

5, I added interactions between the dummy-coded condition variable and the growth variables (i.e., skill acquisition, transition adaptation, reacquisition adaptation) (see Models 4-5; Table 11). Although the AIC supported Model 5, there were no significant interactions between the dummy-coded variable and the growth variables in this model and the BIC supported Model 3. Thus, Model 3 was used as the best-fitting model when predicting performance using the dummy-coded variable as the focal predictor, showing no meaningful differences in growth by condition.

Condition Effects on Emotions: Hypotheses 5 and 6. Hypothesis 5 predicted that an emotion control strategy targeting positive activating emotions would yield higher levels of positive activating emotions than no strategy as well as a strategy that targets positive deactivating emotions. Hypothesis 6 predicted that an emotion control strategy targeting positive deactivating emotions would yield higher levels of positive deactivating emotions than no strategy as well as a strategy that targets positive deactivating emotions. However, the means as reviewed above for positive activating and positive deactivating emotions clearly did not support either Hypothesis 5 or Hypothesis 6. To maintain consistency between my models with performance as the outcome and those with positive activating and deactivating emotions as the outcome, I used the same dummy-coded condition variable in the model building sequence. Separate analyses were conducted with positive activating and positive deactivating emotions as the outcome using the same model building sequence that was used when performance was the outcome (see Table 9 for model building sequence). When positive activating emotions were the outcome, the best-fitting model was Model 1, which included only the growth terms. Similarly, this was the best-fitting model when positive deactivating emotions were the outcome. Additionally, none of the growth variables included in Model 1 were significant for either outcome and as such, these results are not presented in tables. Taken together, the results indicated that there was no significant difference between the emotion control conditions in positive activating or positive deactivating emotion scores experienced while learning the task.

Emotion Scores as Predictors of Performance: Hypotheses 7 and 8. The model building process for Hypotheses 7 and 8 was the exact same as the model building process used for Hypotheses 3 and 4 but with positive activating and positive deactivating emotion scores instead of the emotion control strategies as the focal predictors (see Table 12 for model building sequence). As such, I will not discuss Steps 1 and 2, as the results are the exact same as those shown in Table 10 and mentioned above when discussing Hypotheses 3 and 4. Hypotheses 7 and 8 predicted that positive activating and positive deactivating emotions would be positively and negatively related to performance, respectively. In support of Hypotheses 7 and 8, the results showed that the effect of positive activating emotions was positive and significant ($B = 2.73$, $p < .01$) and the effect of positive deactivating emotions was negative and significant ($B = –1.60$, $p < .05$) (see Model 3, Table 13). Although interactions between positive activating and positive deactivating emotions and growth trends were included in Steps 4 and 5, there was poorer fit for these steps compared to the model in Step 3 that only included the between-person emotion effects without the growth interactions (see Table 13, Model 3, *AIC* = 5550.074; Model 4, *AIC* = 5560.472; Model 5, AIC = 5562.532). Thus, the overall associations between emotion scores and performance supported my hypotheses consistently across skill acquisition, transition adaptation, reacquisition adaptation trends.

Mediation of Condition Effects on Performance via Emotion Scores: Hypotheses 9 and 10. Hypothesis 9 predicted that positive activating emotions and would mediate the beneficial effects of positive activating emotion control on performance, whereas Hypothesis 10 predicted that positive deactivating emotions would mediate the detrimental effects of positive deactivating emotion control on performance. Given the aforementioned results indicated that emotion control conditions did not differ in the levels of positive activating and positive deactivating emotions experienced, neither Hypothesis 9 nor Hypothesis 10 was supported. Furthermore, the results showed that emotion scores did not explain the beneficial effects of positive deactivating emotion control on performance.

Qualitative Analyses and Formative Evaluation

Participants' open-ended responses to the questions presented prior to playing the game and halfway through their participation were coded using a five-step modified constant comparative analysis: (1) data reduction; (2) unitizing, (3) open coding, (4), focused coding, and (5) axial coding (Corbin & Strauss, 2008). Most of the open-ended responses were short, thus in data reduction none of the responses were removed as any of the responses could be relevant to my two research questions for Study 2.

Unitizing often entails breaking down larger responses from interviews or open-ended questions into smaller units (e.g., phrases or paragraphs). Participants' responses were often treated as a single unit given they were fairly short. However, in cases in which the open-ended responses included multiple themes or concepts, the response was split into different units and each unit was coded separately under the corresponding theme or sub-themes.

Next, I compiled a PowerPoint presentation regarding qualitative research and open coding using excerpts from Saldaña (2013). This PowerPoint presentation was shared with undergraduate research assistants at a lab meeting and they were given time to practice generating codes on example responses to several of the open-ended questions. After this, eight research assistants were split into four groups (i.e., two research assistants per group) and were instructed to open code responses for a two-week time period and provide an initial code, or codes to each response for each question. Research assistants were not provided with codes or categories a priori, so the initial open coding was inductive (Glaser and Strass, 1967). For this task, two groups were assigned to the positive activating condition and the two groups were assigned to the positive deactivating condition. Within these conditions, one group of research assistants coded one half of the open-ended responses (e.g., Participants 1-9) and the other group coded the other half of the responses (e.g., Participants 10-18) for the first week. During the second week, the same groups of research assistants coded the remaining responses (i.e., other half of responses) within the same emotion control condition. I also coded responses for all participants and highlighted similarities and differences between my initial codes and those of the research assistants.

In the focused coding step, the initial codes for both emotion control conditions across the different-open ended responses were collapsed into focused codes until new focused codes were no longer frequently generated, suggesting saturation had been reached. The focused codes that were generated represented themes or concepts that appeared across open-ended responses and allowed for similar responses (units) across questions to be grouped under a single code or multiple codes (when responses were split into multiple units—unitized). Once the focused codes were developed, myself and two other graduate students coded a randomly generated subset of responses from nine participants. We used these focused codes and generated additional codes as needed. We then met and refined the focused codes as needed. After settling on the finalized focused codes, myself and another graduate student used the focused codes to go through and independently code all participant responses in each of the emotion control conditions. Last, I used axial coding to examine how these developed categories are related to my two research questions.

Six broad themes were identified through the qualitative coding (see Table 14). Some participants responded similarly across the various open-ended questions, resulting in multiple responses coded under the same theme. However, the frequencies presented in figures and tested in chi-square analyses represent a count of the number of individuals who mentioned the theme at least once in any of their responses to open-ended questions, rather than a total count of each theme, as this would include duplicate responses from participants. Both chi-square frequency and Fisher's exact tests (used when expected counts were less than 5) were used to examine if the differences in counts between those in the positive activating and positive deactivating conditions were statistically significant.

Research Questions. The two research questions were examined by comparing scores from the two emotion control conditions on the Likert, formative evaluation questions coupled with the aforementioned qualitative analysis. Research Question 3 asked what similarities exist in the perceived usefulness between positive activating and positive deactivating emotions. Affective reactions towards the manipulation and reminders were measured using two items. Example items were "I liked the prompt and responding to the open-ended questions at the beginning of the study asking me to reflect on my emotions" and "I liked the reminders that appeared after every two games asking me to reflect on emotion strategies". Participants responded on a 5-point Likert scale (1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree*, 5 = *strongly agree*). Quantitative results showed that participants in both conditions generally liked responding to the prompt and open-ended questions (positive activating: M = 3.50, SD = 0.99; positive deactivating: M = 3.72, SD = 0.83; $t(34)$ = –0.73, p =

.47, $d = 0.24$) but were neutral about the reminders presented throughout the study (positive activating: $M = 3.06$, $SD = 1.16$; positive deactivating: $M = 3.00$, $SD = 0.91$; $t(34) = 0.16$, $p = .87$, $d = 0.06$).

Utility reactions towards the manipulation and reminders were measured using two items: "To what extent were the prompt and questions helpful?" and "To what extent were the reminders in between games helpful?" Participants responded on a 5-point Likert scale (1 = *not at all helpful*, 2 = *slightly helpful*, 3 = *moderately helpful*, 4 = *very helpful*, 5 = *extremely helpful*). The results also showed that participants in both conditions found the prompt and responding to open-ended questions to be moderately helpful (positive activating: $M = 3.11$, $SD = 0.58$; positive deactivating: $M = 2.78$, $SD = 0.88$; $t(34) = 1.34$, $p = .19$, $d = 0.45$) and the reminders to be slightly helpful (positive activating: $M = 2.50$, $SD = 1.15$; positive deactivating: $M = 2.33$, $SD = 1.03$; $t(34) = 0.46$, $p = .65$, $d = 0.16$). In general, the results from the formative evaluation, Likert questions showed that the two emotional control conditions yielded similar affective and utility reactions, both conditions were perceived overall to be modestly liked and useful.

While these results suggest that similarities exist between the two conditions regarding their overall perceptions of the prompt, open-ended questions, and reminders, it does not speak to participants' subjective perceptions of why the positive activating and positive deactivating emotions were useful. However, this was gleaned from the qualitative coding of the open-ended responses. Three broad themes emerged in open-ended responses that were similar between those in the positive activating condition compared to those in the positive deactivating condition: (1) learning, (2) performance, and (3) frame of reference.

As shown in Figure 8, many of the participants in both conditions noted that the emotions respective to their conditions were useful for learning and performance. With respect to Research Question 3, chi-square tests of independence showed that the association between emotion control condition and learning (χ^2 (1, N = 36) = 0.44, p = .51) as well as the association between emotion control condition and performance (χ^2 (1, N = 36) = 0.44, p = .51) were not statistically significant. This indicates the number of individuals who mentioned learning or performance in their responses did not significantly differ between the emotion control conditions. Responses categorized under learning often mentioned idea generation or learning from past experience, whereas those categorized under performance centered around achievements and often mentioned wanting to achieve a certain level of performance or success. For example, the responses below highlight two participants' focus on how emotions can benefit learning.

> *"It can help me think about what I did wrong and what I could do better in the future…*"

> *"They kept reminding me to think of how I could improve and what I did to improve during that previous experience."*

In other responses, participants mentioned how emotions could benefit performance.

> *"It will make me want to continue to get better and learn how to do good in the game so I can be one of the best."*

> *"I can also focus on performing better and realizing that if I feel calm then I'll be able to improve my skills."*

Sometimes participants mentioned aspects of both learning and performance in this same thought. Consistent with unitizing, the response was split into separate units and one unit was coded under both the broad learning theme, while the other unit was coded under the broad performance theme. For example, one participant noted:

> "*By focusing on the improvements I make, no matter how small, I can aim for bigger achievements."*

As shown in Figure 8, the majority of participants in both conditions noted that the open-ended prompts and reminders changed their frame of reference when approaching the task. With respect to Research Question 3, a chi-square test of independence showed that the association between emotion control condition and frame of reference was not statistically significant (χ^2 (1, N = 36) = 1.18, p = .28), indicating the number of individuals who mentioned the prompts and reminders changed their frame of reference in their responses did not significantly differ between the emotion control conditions. In general, responses often included reflecting on how emotions influenced their past experience(s) and thinking about these experiences when approaching the current task. For example, several participants mentioned how the prompt made them think about past experiences and apply it to approaching the current task.

> *"The prompt questions provided at the beginning of the study made me think about times I have been calm, as well as how I calm myself down. This made me think about my heart rate and breathing while playing the game."*

> *"They were helpful because they helped me think about times when I was happy so I could mimic that and be happy during this study."*

Another participant described having a greater awareness of their current emotions after seeing the reminders in between games.

> *"By the end of games I would forget that I am trying to be happy so I would get a little mad but then before I started a new game I would always attempt to keep myself happy and after repeating this a number of times, I believe that I began to be happy for longer each time I would read the messages. The happiness would last longer the more times that I would see the message."*

Research Question 4 asked what differences exist in the perceived usefulness between positive activating and positive deactivating emotions. While the quantitative analyses of the Likert, formative questions showed that there was little difference between the emotion control conditions regarding their overall reactions, in contrast, the qualitative results suggested that there were differences between the conditions regarding three broad themes: (1) emotion regulation, (2) cognitive processes, and (3) motivation.

As shown in Figure 8, emotion regulation was generally mentioned more in the positive deactivating condition compared to the positive activating condition. While the Fisher's exact test did not reach statistical significance ($p = .12$), indicating the difference in frequencies between the emotion control conditions was not statistically significant for this broad theme, the results discussed below for its sub-themes did show statistically significant differences. Responses coded under the broad theme of emotion regulation centered around maintaining, up-regulating (i.e., increasing), or down-regulating (i.e., decreasing) emotions, without mentioning which specific emotions were regulated. Participants in the positive deactivating condition often iterated that the prompt and reminders helped them regulate and become more aware of their emotions.

> *"It helps the player to keep in mind the impact his or her emotions have on his or her performance. It also implies that in order to perform better, one must keep emotions from interfering with one's game play."*

> *"They made me self-aware of how my emotions were at the time."*

> *"They helped me to archive my emotions."*

As shown in Figure 8, cognitive processes were mentioned more in the positive deactivating condition compared to the positive activating condition. The Fisher's exact test was statistically significant ($p < 0.05$), indicating the number of individuals who mentioned cognitive processes in their responses significantly differed between the emotion control conditions. Responses coded under the broad theme of cognitive processes centered around decision-making and encoding of information. Several participants in the positive deactivating condition expressed how feeling *calm*, *relaxed*, and *at ease* helped decision-making and could improve encoding.

> *"Being calm made me think about decisions a lot more, not just rushing into gameplay because I wanted to get revenge...etc."*

> *"If my mind stays calm I can keep making decisions with intent and be able to succeed."*

> *"When I am calm it may help me take in more information as opposed to trying to force information into my brain."*

As shown in Figure 8, motivation was mentioned more in the positive activating condition. While the Fisher's exact test for the broad motivation theme ($p = .09$) did not reach statistical significance, the results discussed below for its sub-themes did show statistically significant differences. Responses coded under the broad theme only mentioned motivation but did not specify constructs related to motivation or factors that increased motivation to learn and improve.

> *"When I was excited, it made me more motivated to learn how to do it and I did not dread having to learn how to do it."*

> *"It helped had me become more motivated and wanting to become the best I could be."*

Furthermore, within the broad themes (i.e., emotion regulation, cognitive processes, motivation) specific sub-themes emerged that showed statistically significant differences. The sub-themes for emotion regulation were: (1) up-regulating and/or maintaining positive activating emotions, (2) up-regulating and/or maintaining positive deactivating emotions, and (3) down-regulating negative emotions. As shown in Figure 9, there were little differences in frequencies for the first sub-theme, whereas the frequencies for the latter two sub-themes were higher for those in the positive deactivating condition. Accordingly, the Fisher's exact test for up-regulating and/or maintaining positive deactivating emotions was not significant ($p = .60$), whereas the chi-square tests for up-regulating and/or maintaining positive deactivating emotions (χ^2 (1, N = 36) =

4.21, $p < .05$) and down-regulating negative emotions were statistically significant (χ^2 (1, N = 36) = 7.11, $p < .01$). The results indicate that the number of individuals who mentioned the latter two sub-themes in their responses significantly differed between the emotion control conditions and responses for these sub-themes are included below.

Those in the positive deactivating condition expressed several ways in which they could help maintain or increase positive deactivating emotions while learning the task.

> *"Controlling my breathing and talking myself through situations in my head will keep me at ease."*

> *"I can take a moment to slow down and breath. Also relax my body."*

> *"Deep breathes can keep me calm and focused."*

Further, those in the positive deactivating condition explained how experiencing positive deactivating emotions could help with maintaining or down-regulating negative emotions. For example, several participants mentioned how feeling *calm*, *relaxed*, and *at ease* were beneficial for reducing feelings of frustration or shame.

> *"Feeling calm, relaxed, and at ease helps me to think clearly about what specifically I need to work on and to not be frustrated with my inability to do something."*

> *"These feelings will keep me from becoming frantic and frustrated with the controls."*

> *"It helped me to stop beating myself up over not getting the specifics and let me go back to the basics without feeling ashamed about starting over. Overall it was about feeling shameless."*

Others mentioned how these feelings were helpful for reducing anxiety or pressure.

> *"Contrary to feelings of anxiety, calmness and feeling relaxed helped me to stop overthinking the situation."*

> *"It helps because you don't stress over the things that are difficult. You stay persistent and continue with the struggle at-hand."*

> *"I didn't feel pressured in any way which allowed me to be more effective in my progression throughout the game."*

The sub-themes for cognitive processes were: (1) improving focus and (2) improving retention/recall. As shown in Figure 10, those in the positive deactivating condition mentioned focus more often and the chi-square test was statistically significant (χ^2 (1, N = 36) = 9.75, $p <$ .01). However, the frequencies for the improving retention/recall sub-theme were identical for the two conditions. Over half of the participants in the positive deactivating condition described the importance of feeling *calm*, *relaxed*, and *at ease* for helping them to focus.

> *"Feeling calm, relaxed, and at ease helped me make progress by keeping my head in one place. It was easy for me to concentrate because I didn't feel rushed."*

> *"Feeling calm, relaxed, and at ease can be helpful because I can think about the game in a focused way without stress."*

> *"The tournament is really sensitive with the movements but being calm will help be focus throughout."*

The sub-themes for motivation were: (1) drive, (2) persistence, (3) confidence, (4) enjoyment, and (5) competition. As shown in Figure 11, all of the motivation sub-themes were mentioned more in the positive activating condition. Though the frequencies were higher for drive, the Fisher's exact test (p = .09) did not reach conventional levels of significance. Of the other sub-themes, the chi-square tests showed that only persistence (χ^2 (1, N = 36) = 4.50, $p <$ .05) and enjoyment (χ^2 (1, N = 36) = 5.60, $p <$ .01) were statistically significant, indicating the number of individuals who mentioned these sub-themes in their responses significantly differed between the emotion control conditions. The Fisher's exact tests for confidence (p = .66) and competition (p = .23) were not significant. Given drive was trending toward statistical significance and often mentioned in tandem with motivation, responses below highlight this sub-theme and the other two significant sub-themes.

Sometimes participants mentioned both motivation and drive as influencing their willingness to learn and improve.

> "*Feeling those emotions keep me motivated and driven to get better at a game."*

> *"I was motivated and driven to become the best person I can be."*

Other participants described how feeling *excited*, *enthusiastic*, and *happy* helped them to persist (i.e., continue to learn and improve over time) and how the absence of these feelings might lead to a lack of persistence.

> *"Being excited made me want to keep going back to play and every time I played I would notice something new or learn a new way some of the enemies behaved and that let me improve every time I went back which made me more excited and kept me playing."*

> *"It will make me want to continue playing and thus, improving."*

> *"These feelings helped because if you didn't feel this way while learning a new task you most likely were not going to continue to practice it."*

Participants often described a sense of enjoyment associated with feeling *excited*, *enthusiastic*, and *happy*.

> *"It made it easier to get up and go train, I knew that I was working harder than anyone else to achieve my goal. It's a lot easier to work when you are having fun than when you're not."*

> *"If I was to feel this way while learning this game it would make time go by quicker because I would be enjoying a game and it would help me to improve."*

> *"The more I enjoy the game, the more I will play. The more I play, the better I get at playing it."*

Discussion

Study 2 extended Study 1 and the existing empirical literature by comparing the effectiveness of two emotion control strategies using both quantitative and qualitative methods. In general, the quantitative results showed that the emotion control strategy targeting positive deactivating emotions was associated with higher performance scores, but this was not reflected in higher positive activating or positive deactivating emotion scores. The qualitative results highlighted meaningful differences between the emotion control conditions regarding learner perceptions of why the respective emotions were useful that can speak to these quantitative findings.

Given the results of Study 1, I expected that the emotion control strategy targeting positive activating emotions would exhibit a positive relationship with performance. In contrast, the results showed that the emotion control strategy targeting positive deactivating emotions was associated with higher performance scores throughout acquisition and adaptation, whereas there were little difference in performance scores between the positive activating and no emotion control conditions (see Figure 5). Additionally, the differences in performance scores between the conditions seemed to be larger in adaptation compared to acquisition, though this was not statistically significant. While the specific findings were not consistent with my expectations given the findings of Study 1, they are consistent with previous research that has shown positive indirect relationships between emotion control strategies and adaptation (transfer) performance via acquisition performance (Bell & Kozlowski, 2008; Kanfer & Ackerman, 1996).

Another expectation was that the emotion control strategies would increase the respective emotions experienced while learning the task. Contrary to previous research showing a similar mediated relationship (e.g., Bell & Kozlowski, 2008), the quantitative results showed little differences in positive activating and positive deactivating emotion scores between individuals in the emotion control conditions. As such, the mediation model was not supported because the emotion control strategies were not associated with increases in self-reported positive activating or positive deactivating emotion scores. In other words, the results showed that the positive relationship between positive deactivating emotion control and performance was not explained by increases in emotion scores. However, the qualitative analyses suggested other routes through which the emotion control strategy targeting positive deactivating emotions influenced performance.

While the broad themes of learning, performance, and frame of reference were similar between the positive activating and positive deactivating emotion control conditions, the broad themes of emotion regulation, cognitive processes, and motivation and the corresponding sub-themes showed statistically significant differences between the conditions. In particular, two main themes emerged in the qualitative results that likely speak to the usefulness of positive deactivating emotions in the context of complex skill learning and may explain why emotion scores did not differ between the conditions. The first theme was that staying *calm*, *relaxed*, and *at ease* helped emotion regulation, particularly by down-regulating negative emotions. Many of the participants mentioned that positive deactivating emotions helped reduce *anger*, *frustration*, *anxiety*, or feelings of *pressure*. The second theme that emerged was that feeling *calm*, *relaxed*, and *at ease* improved general cognitive processes (e.g., decision-making, encoding) and focus. Participants often noted that feeling *calm*, *relaxed*, and *at ease* allowed them to approach the task in a more focused way and that they were able clearly think through decisions or even make better decisions. Both of the qualitative themes are consistent with previous recommendations suggesting that emotion control is important as it promotes the allocation of attentional resources to on-task rather than off-task thoughts (e.g., worry) (Kanfer & Ackerman, 1989; 1996). In general, these results suggested that the positive relationship between the positive deactivating emotion control strategy and performance might be explained by processes not captured in the self-report measures of emotions.

General Discussion

Both Study 1 and Study 2 contribute to the existing literature by taking a more nuanced approach to studying emotion-performance relationships (Study 1) and emotion control strategies (Study 2) within the context of complex skill learning. In Study 1, I examined the incremental effects of both positive and negative discrete emotions over and above general positive and negative affect. The results were used to determine whether it would be more beneficial to target discrete emotions or general positive or negative feelings and thoughts in emotion control interventions. Thus, the results of Study 1 were used to develop emotion control strategies tailored to the performance context for Study 2. Two emotion control strategies: one targeting specific positive activating (i.e., excited, enthusiastic, happy) and another targeting positive deactivating (i.e., calm, relaxed, at ease) emotions were compared to a no emotion control strategy condition to disentangle which aspects of emotion control benefit performance. In the following sections, I review the theoretical and practical implications for the studies, as well as the limitations and avenues for future research.

Theoretical Implications

Although experimental manipulations of emotions are important for understanding cause-and-effect relationships between emotions and performance, previous meta-analytic findings suggest that many studies have largely used correlational designs in which emotions were examined via self-report measures (Shockley et al, 2012). Similarly, prior research examining emotion control strategies has largely relied on correlational designs, with the exception of two experimental studies (i.e., Bell & Kozlowski, 2008; Kanfer & Ackerman, 1996). However, the results of the present studies demonstrate that correlational findings might not be supported in experimental studies examining cause-and-effect relationships. While the correlational analyses from both studies showed that self-reported positive activating emotion scores and not positive deactivating emotion scores were consistently and positively related to performance, the analyses of the experimental conditions showed an opposite finding. Specifically, the findings from the experimental manipulation showed that the emotion control strategy targeting positive deactivating emotions was associated with higher performance scores. Furthermore, the qualitative results suggested that this was most likely due to the associations between positive deactivating emotions and cognitive or attentional processes, and not via emotions per se.

The notion that specific positive emotions are interrelated with cognition and attention is not a new idea. One of the fundamental principles of the discrete approach to studying emotions is that the initial cognitive appraisal of the situation influences which cognitive processes are stimulated and this in turn leads to various behavioral outcomes (Ellsworth & Scherer, 2003; Smith & Ellsworth, 1985). This perspective inherently implies that emotional experiences are heavily tied to cognition. For example, while pride and surprise are both positive emotions, the two emotions vary on the cognitive appraisal dimensions of certainty and other-responsibility. Pride is associated with the high certainty (i.e., situation is predictable) and low other-responsibility (i.e., responsibility for the outcome attributed to other individuals), whereas surprise is associated with low certainty and high other-responsibility (Lerner, Valdesolo, & Kassam, 2014; Smith & Ellsworth, 1985). Similarly, meta-analytic findings showed differences in relationships between positive (e.g., happiness) and negative (e.g., anger, guilt, fear) discrete emotions and various judgment and decision-making outcomes (Angie, Connelly, Waples, Kligyte, 2011). Unfortunately, this research has not included positive deactivating emotions such as *calm* and *relaxed*, but given the findings of the qualitative research one might expect that positive deactivating emotions would be associated with various cognitive processes (e.g., attentional activity, anticipated effort). Further, the qualitative findings reify the importance of allocating attentional resources towards rather than away from task demands (Kanfer & Ackerman, 1989; 1996). Prior research suggests that emotion control should benefit performance by directing attention to on-task thoughts (e.g., acquiring task demands and procedures) rather than off-task thoughts (i.e., anxiety) (Kanfer & Ackerman, 1996), though much of this research has focused largely on prompting general positive thoughts. The qualitative results provided support for this perspective and suggested that positive deactivating emotions, in particular, were positively associated with performance scores by focusing attention to the task and reducing off-task thoughts (i.e., negative emotions). As such, one would expect little differences in positive activating and positive deactivating emotion scores as the emotion control strategy targeting positive deactivating emotions likely influenced cognitive processes and attention rather than self-reported positive emotion scores. Importantly, these experimental findings imply that the benefit of an emotion control strategy may not be captured in measures of emotions. As such, additional measures capturing cognitive processes and attention need to be included in future research to adequately reflect how emotion control strategies benefit learning and performance.

Alternatively, the qualitative results might suggest that although both emotion control strategies were intended to help individuals regulate their emotions, the emotion control strategy targeting positive deactivating emotions served as more of a mindfulness manipulation. Mindfulness is an "intentional attentiveness to present moment experience with an orientation of curiosity, openness, and acceptance" (Bartlett et al., 2019, p. 108). Researchers have suggested that mindfulness can influence attention and emotions (Creswell & Lindsay, 2014). In support of this notion, a recent meta-analysis found that mindfulness interventions were associated with a reduction in stress and anxiety (Bartlett et al., 2019). However, the results regarding attention were mixed (Bartlett et al., 2019). For my Study 2, participants in the positive deactivating condition often mentioned that they could use body relaxation exercises or breathing exercises to help them stay *calm*, *relaxed*, and *at ease*, both of which are common components of mindfulness interventions (Bartlett et al., 2019). Additionally, participants often mentioned that positive deactivating emotions were useful for being able to approach the task in a more focused way or without anxiety or worry, both of which are suggested benefits of mindfulness. Accordingly, one might argue that the emotion control prompt targeting deactivating emotions in Study 2 might have led individuals to be more mindful when approaching the task and this mindfulness was beneficial to their learning.

Although the dual pathway model (De Dreu et al, 2008) suggests that positive deactivating emotions should have null or negative relationships with performance due to their lack of activation (arousal), the present experimental findings suggested that this may not be the case for the performance context used in the present studies. Rather, the qualitative findings showed that positive deactivating emotions might also be “activating” of cognitive processes and performance, despite low arousal of emotions as they narrowed attention to task demands by drawing focus to the task and facilitated encoding and decision-making. As such, the positive deactivating emotions seemed to operate similarly to negative activating emotions (e.g., anger, fear) in the dual pathway model as they were associated with activating convergent thinking and more narrowed attention. While these findings suggested that the low arousal of positive deactivating emotions might be beneficial for learning and performance, there may be another dimension (i.e., regulatory focus) underlying moods and emotions that could potentially explain these findings.

Regulatory focus refers to an individual’s promotion or prevention focus and underlying behaviors (Higgins, 1997). Promotion focus entails approach behaviors with goal pursuit centered on accomplishments (e.g., success), whereas prevention focus involves avoidance behaviors with goal pursuit focused more on threats (e.g., failure) (Higgins, 1997). As such, the presence or absence of positive outcomes are associated with promotion focus, whereas the presence or absence of negative outcomes are associated with prevention focus (Baas et al., 2008; Higgins, 1997). From this perspective, when individuals are able to attain positive outcomes (e.g., success), they are likely to experience promotion-focused positive moods or emotions (e.g., happiness), whereas if they don't attain the positive outcomes, they experience promotion-focused negative moods or emotions (e.g., disappointment, anger) (Carver, 2004; Higgins, 1997; 2006). In contrast, when individuals are able to avoid negative outcomes (e.g., failure), they are likely to experience prevention-focused positive moods or emotions (e.g., calm), whereas if they do not avoid negative outcomes, they experience prevention-focused negative moods or emotions (e.g., worry, fear) (Carver, 2004; Higgins, 1997; 2006). Previous research has shown that promotion focus is associated with the broadened attention and prevention focus is associated with the more narrowed attention (Friedman and Förster & 2001). From this perspective, *calm*, *relaxed*, and *at ease* are associated with a prevention focus and thus the qualitative findings provided support for this perspective by showing that these prevention-focused emotions were associated with more convergent thinking. Additionally, from an emotion control perspective if the goal is to "keep negative emotions at bay" so that individuals can learn the relevant facts about task demands and procedures, then the regulatory focus perspective suggests that prevention-focused positive emotions are useful as these emotions are associated with the "successful avoidance" of negative outcomes. That is, perhaps adopting a positive deactivating emotion control strategy is beneficial because it focuses one's attention on how to "clean up" performance by eliminating errors in the execution of task strategies (i.e., refining existing strategies rather than exploring new ones; Hardy et al., 2019). As such, future research would benefit by examining relationships between regulatory focus, emotions, and performance.

Practical Implications

From a practical standpoint, the present findings suggest that for complex, fast-paced performance domains, it is beneficial to prompt learners to stay *calm*, *relaxed*, and *at ease*. Although previous research using more general emotion control strategies (i.e., Bell & Kozlowski, 2008; Kanfer & Ackerman, 1996) have found indirect relationships between their strategies and transfer performance, the present research found a direct performance benefit from a strategy that targeted this specific combination of emotions and performance. These findings suggest that while broad strategies can be useful, targeting specific positive emotions may be even more beneficial given the direct benefit to performance. However, future research comparing targeted versus broad emotion control strategies is needed to determine if the emotion control strategy targeting positive deactivating emotions is more effective compared to the broad emotion control strategies supported in the published literature.

Additionally, though emotion control strategies in the complex skill acquisition literature often include a component discussing curbing negative emotions or thoughts, the present findings suggest that this component may not be necessary when targeting positive deactivating emotions. Qualitative results showed that individuals in the positive deactivating condition mentioned that the respective emotions helped them to down-regulate negative emotions. These findings are consistent with the "undoing hypothesis" which suggests that positive emotions, such as excitement and contentment, can help mitigate the arousal prompted by negative emotions (Fredrickson, Mancuso, Branigan, & Tugade, 2000). However, in order to support such a claim, one would need to develop a more comprehensive emotion control strategy in which both positive deactivating emotions as well as negative emotions (e.g., anxiety, frustration) are targeted. Future research could then compare the effectiveness of the comprehensive strategy targeting both positive deactivating and negative emotions to the emotion control strategy targeting only positive deactivating emotions.

Limitations and Future Research

There are several limitations that must be considered when interpreting the results of the present studies. First, the task (UT2004) I used was complex, fast-paced, and required strong cognitive and perceptual motor demands. While I was fortunate in that I was able to study emotion-performance relationships in the same context for both studies, certain aspects of the findings may be constrained to complex, fast-paced performance domains with similar cognitive and perceptual motor demands, such as eSports and aviation. Moreover, UT2004 is suitable for studying self-regulated learning and emotion-performance relationships given its relevance to many contemporary simulation- and game-based training contexts, which have rapidly grown in popularity in the public and private sectors (American Society for Training and Development, 2015). In particular, UT2004 involves technology-mediated, shifting, ambiguous, and emergent task qualities that are inherent in many virtual and game-based training environments (Hardy, Day, & Steele, 2018; Keith & Wolff, 2015; Kozlowski et al., 2001). For example, with respect to Study 2, certain characteristics of the task may have made it more difficult for individuals in the positive activating condition to maintain positive activating emotions (i.e., *enthusiastic*, *happy*, *excited*) over time or may have shifted attention to motivational aspects of the task (i.e., goals, competition) that were detrimental to performance. Additionally, study characteristics may have amplified the benefit of maintaining positive deactivating emotions (i.e., *calm*, *relaxed*, *at ease*) for those in the positive deactivating condition. Given emotions are highly context driven

(Ashkanasy & Dorris, 2017), future research is needed to examine emotion-performance relationships across other performance domains.

Second, while the emotion control strategies were perceived to be useful and were developed based on the results from Study 1, there may be other emotion control strategies that could equally benefit individuals in the context of complex skill learning. Although the emotion control literature has largely focused on reducing negative thoughts and increasing positive thoughts, the broader emotion regulation literature has focused on a number of emotion regulation strategies that might influence learning and performance. Cognitive appraisal (i.e., reframing the situation) and suppression (i.e., reducing or inhibiting emotion feelings or expressions) are two strategies that have received empirical attention (Gross et al., 2006). In general, cognitive appraisal is associated with greater well-being and experiencing more positive emotions, whereas suppression is associated with the opposite (Gross & John, 2003). While these strategies are common, other specific strategies exist (e.g., situation selection, situation modification, attentional deployment; Gross, 1999). For example, given negative emotions (e.g., frustration, anxiety) are likely to occur early on in complex skill acquisition, it might be beneficial to have individuals regulate negative emotions by reframing mistakes as learning opportunities (cognitive reappraisal). A similar approach—error management training—has been used in the training literature and has been shown to benefit transfer performance (Keith & Frese, 2005). Further, meta-analytic results show that experimental studies have used a variety of methods to prompt these specific emotion regulation strategies, though most manipulations have been used to regulate negative emotions or affect (moods) (Webb, Miles & Sheeran, 2012). Future research may be informed by drawing upon this literature to help develop other strategies in an effort to assess cause-and-effect relationships between emotions and performance. In general, experimental research would greatly benefit our understanding of emotion-performance relationships and could inform how to best help individuals regulate their emotions in a way that is beneficial to learning and performance.

Third, though the qualitative component of the Study 2 was useful for uncovering themes and further exploring how individuals perceive emotions influence performance, some of the responses highlighted potential issues of the prompt in combination with the open-ended questions. In particular, the wording and nature of the prompt and open-ended questions may have constrained responses. Participants were asked to describe how their emotions could help them learn and improve and were then asked how the specific emotions could be useful. A small handful of individuals stated that the emotions were useful for helping them learn or improve. Thus, these individuals reiterated pieces of the first question in their response to the second. Additionally, responses to the open-ended questions were often extremely short. Future research may benefit by using less constrained methods in which participants can be asked to elaborate upon their answers, such as focused interviews or focus groups. Doing so may provide rich information about the underlying processes of emotions and how they are useful for learning and performance.

Fourth, in both of the studies, emotions were assessed using self-report measures that are commonly used in the literature. However, one of the main takeaway points from Study 2 was that these measures might not adequately capture emotion experiences and the cognitive processes that underlie emotions. Additionally, scholars have lamented the reliance on self-report assessments of emotions and instead recommended that researchers incorporate other methods for measuring emotions (Ashkanasy & Dorris, 2017). Future research would likely benefit by using measures that assess cognitive processes tied to emotions and by supplementing self-report measures with physiological or neurological measures of emotions experienced while engaging with the task.

Last, although the sample size was large for the first study, it was relatively small for the second study due to the sudden end to the data collection stemming from COVID-related health and safety concerns. As such, many of the quantitative findings must be interpreted with caution as the small sample size could potentially bias the results. However, the small sample size is less of an issue for the qualitative data as it provides rich details about perceptions and centers around exploring general themes rather than meeting a specific threshold of significance. Thus, future research should seek to replicate the findings of Study 2.

Conclusion

In summary, the results of the present research suggest that researchers should be wary of providing concrete recommendations regarding the use of emotion control strategies based on correlational findings alone. Although positive activating emotion scores (i.e., enthusiastic, excited, happy) were positively related to performance across both studies, prompting these positive activating emotions in a targeted emotion control strategy did not translate into higher performance scores. Interestingly, individuals who were presented with the emotion control strategy targeting positive deactivating emotions (i.e., calm, relaxed, at ease) had higher performance scores in comparison to the emotion control strategy targeting positive activating emotions and the no emotion control strategy condition. The results support the common notion of "keeping calm" when learning a complex skill. Qualitative analyses suggested that even though these emotions are associated with lower levels of arousal, they contribute to performance by improving cognitive processes and attentional focus rather than changes in emotions per se. Thus, I speculate that emotion control strategies do not benefit performance by increasing positive emotions, but by influencing other factors (i.e., cognitive processes, attentional focus) that are related to performance. I hope the present research prompts future studies that examine cause-and-effect relationships between emotions and performance using mixed-method designs. Such research would be useful for informing the development and use of specific emotion control strategies that are appropriately tailored to the performance contexts of interest.

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Table 1

Study 1: Descriptive Statistics and Correlations for Positive Emotions and Performance

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10
1. ACT	26.86	4.17										
2. Videogame experience	0.04	1.01	.19**									
3. Sex[1]			–.20**	–.55**								
4. Positive affect[2]	3.98	1.49	.20**	.39**	–.44**							
5. Enthusiastic[3]	3.81	1.81	.20**	.37**	–.39**	.84**						
6. Excited[3]	3.84	1.86	.19**	.38**	–.39**	.80**	.97**					
7. Happy[3]	3.90	1.82	.18**	.40**	–.44**	.89**	.89**	.87**				
8. At ease[3]	4.03	1.73	.18**	.29**	–.33**	.84**	.47**	.42**	.57**			
9. Calm[3]	4.29	1.75	.10*	.25**	–.31**	.79**	.38**	.31**	.51**	.88**		
10. Relaxed[3]	4.03	1.75	.12*	.27**	–.35**	.85**	.47**	.41**	.59**	.89**	.90**	
11. Performance[3]	33.41	16.90	.34**	.67**	–.70**	.54**	.54**	.53**	.56**	.37**	.31**	.38**

Note. [1]Sex: male = 0, female = 1. [2]Average score of all positive emotions across all sessions (Sessions 1-14). [3]Average score across all sessions. $N = 467$. *$p < .05$, **$p < .01$

Table 2

Study 1: Descriptive Statistics and Correlations for Negative Emotions and Performance

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. ACT	26.86	4.17														
2. Videogame experience	0.04	1.01	.19**													
3. Sex[1]	0.37	0.48	−.20**	−.55**												
4. Negative affect[2]	3.66	1.53	−.20**	−.30**	.38**											
5. Angry[3]	3.20	1.88	−.20**	−.21**	.30**	.86**										
6. Anxious[3]	3.06	1.79	−.14**	−.21**	.29**	.80**	.82**									
7. Frustrated[3]	4.04	2.03	−.18**	−.29**	.39**	.93**	.83**	.70**								
8. Irritated[3]	4.04	1.96	−.21**	−.29**	.37**	.93**	.80**	.69**	.94**							
9. Tense[3]	3.82	1.82	−.09*	−.23**	.29**	.82**	.70**	.80**	.75**	.74**						
10. Uneasy[3]	3.14	1.73	−.18**	−.25**	.29**	.84**	.68**	.73**	.73**	.74**	.81**					
11. Bored[3]	4.21	2.01	−.18**	−.18**	.23**	.48**	.22**	.12**	.37**	.40**	.11*	.25**				
13. Disappointed[3]	3.47	1.90	−.21**	−.25**	.29**	.89**	.79**	.68**	.83**	.80**	.68**	.71**	.35**			
13. Discouraged[3]	3.23	1.91	−.20**	−.29**	.34**	.90**	.80**	.70**	.84**	.82**	.71**	.72**	.34**	.92**		
14. Fatigued[3]	4.43	2.06	−.06	−.23**	.29**	.61**	.34**	.29**	.51**	.51**	.37**	.41**	.57**	.38**	.41**	
15. Performance[3]	33.41	16.90	.34**	.67**	−.70**	−.52**	−.39**	−.35**	−.50**	−.50**	−.33**	−.43**	−.40**	−.45**	−.48**	−.36**

Note. [1]Sex: male = 0, female = 1. [2]Average score of all negative emotions across all sessions (Sessions 1-14). [3]Average score across all sessions.
$N = 467$. $*p < .05$, $**p < .01$

Table 3
Coding Scheme of Change Variables in Discontinuous Mixed-Effects Growth Models

Variable	Pre-change period							Post-change period						
Measurement Occasion	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Skill acquisition (SA)	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Transition adaptation (TA)	0	0	0	0	0	0	0	1	1	1	1	1	1	1
Reacquisition adaptation (RA)	0	0	0	0	0	0	0	0	1	2	3	4	5	6
Quadratic skill acquisition (SA^2)	0	1	4	9	16	25	36	36	36	36	36	36	36	36
Quadratic reacquisition adaptation (RA^2)	0	0	0	0	0	0	0	0	1	4	9	16	25	36

Note. Skill acquisition refers to the linear rate of acquisition (i.e., performance improvements) in pre-change period. Transition adaptation models discontinuity with a dummy coded variable indicating when task change has occurred and compares pre-change to the post-change period. Interpreted in relation to skill acquisition – effect reflects a different in performance after task change relative to value predicted by skill acquisition immediately following the task change. Reacquisition adaptation refers to linear rate of acquisition in the post-change period. Interpreted in relation to skill acquisition – change in rate of acquisition following task change relative to the rate of acquisition in skill acquisition. Quadratic skill acquisition and quadratic reacquisition adaptation were included to account for curvilinear change.

Table 4

Study 1: Model Building for the Discontinuous Mixed–Effects Growth Models of Performance Change

	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
Intercept, γ_{00}	X					
Skill acquisition, γ_{10}	X					
Transition adaptation, γ_{20}	X					
Reacquisition adaptation, γ_{30}	X					
Quadratic skill acquisition, γ_{40}	X					
Quadratic reacquisition adaptation, γ_{50}						
Sex[1], γ_{01}		X				
ACT, γ_{02}		X				
Videogame experience (VGE), γ_{03}		X				
General Dimension Minus Discrete[2] (Between-person), γ_{04}			X			
General Dimension Minus Discrete[2] (Within-person), γ_{60}			X			
Discrete Emotion (Between-person), γ_{05}				X		
Discrete Emotion (Within-person), γ_{70}				X		
General Dimension Minus Discrete[2] (Between-person) × Skill acquisition, γ_{14}					X	
General Dimension Minus Discrete[2] (Between-person) × Transition adaptation, γ_{24}					X	
General Dimension Minus Discrete[2] (Between-person) × Reacquisition adaptation, γ_{34}					X	
General Dimension Minus Discrete[2] (Within-person) × Skill acquisition, γ_{80}					X	
General Dimension Minus Discrete[2] (Within-person) × Transition adaptation, γ_{90}					X	
General Dimension Minus Discrete[2] (Within-person) × Reacquisition adaptation, γ_{100}					X	
Discrete Emotion (Between-person) × Skill acquisition, γ_{15}						X
Discrete Emotion (Between-person) × Transition adaptation, γ_{25}						X
Discrete Emotion (Between-person) × Reacquisition adaptation, γ_{35}						X
Discrete Emotion (Within-person) × Skill acquisition, γ_{110}						X
Discrete Emotion (Within-person) × Transition adaptation, γ_{120}						X
Discrete Emotion (Within-person) × Reacquisition adaptation, γ_{130}						X

Note. [1]Sex: male = 0, female = 1. [2]The incremental prediction was determined by examining the effect for each discrete emotion after controlling for effect of the general dimension without including the specific discrete emotion. For example, *happy* was examined over the sum of all other positive discrete emotions (i.e., *enthusiastic, excited, at ease, calm, relaxed*). Separate analyses were conducted for each of the 16 discrete emotions. Level 1 accounted for autocorrelation (AR1) in error structures.

Table 5

Study 1: Discontinuous Mixed–Effects Growth Models of Performance Change

	Model 1			Model 2		
Variable	*B*	*SE*	*t*	*B*	*SE*	*t*
Intercept, γ_{00}	28.25	0.84	33.51**	33.74	0.70	48.24**
Skill acquisition, γ_{10}	5.36	0.27	19.93**	5.36	0.27	19.87**
Transition adaptation, γ_{20}	–18.63	0.62	–29.90**	–18.50	0.59	–31.34**
Reacquisition adaptation, γ_{30}	–4.41	0.42	–10.50**	–4.62	0.29	–16.13**
Quadratic skill acquisition, γ_{40}	–0.55	0.04	–13.06**	–0.55	0.04	–13.01**
Quadratic reacquisition adaptation, γ_{50}	–0.04	0.06	–0.66			
Sex[1], γ_{01}				–14.76	1.12	–13.22**
ACT, γ_{02}				0.69	0.11	6.25**
Videogame experience (VGE), γ_{03}				5.94	0.54	11.11**

Note. [1]Sex: male = 0, female = 1. Level 1 accounted for autocorrelation (AR1) in error structures.
N between-person = 467; *N* within-person = 6,538. ***p* < .01.

Table 6

Study 1: Discontinuous Mixed–Effects Growth Models of Performance Change as a Function of Positive Emotions

		Model 4		
Variable	*r*	*B*	*SE*	*t*
Activating				
Enthusiastic (Between-person)	.54**	**1.76**	**0.36**	**4.84****
Enthusiastic (Within-person)		**0.72**	**0.08**	**8.84****
Excited (Between-person)	.53**	**1.56**	**0.33**	**4.82****
Excited (Within-person)		**0.85**	**0.08**	**10.51****
Happy (Between-person)	.56**	**1.99**	**0.42**	**4.69****
Happy (Within-person)		**0.80**	**0.09**	**9.24****
Deactivating				
At Ease (Between-person)	.37**	**–0.92**	**0.38**	**–2.44***
At Ease (Within-person)		**0.21**	**0.07**	**3.01****
Calm (Between-person)	.31**	**–1.25**	**0.33**	**–3.80****
Calm (Within-person)		–0.03	0.07	–0.43
Relaxed (Between-person)	.38**	**–0.81**	**0.39**	**–2.09***
Relaxed (Within-person)		0.12	0.07	1.56

Note. Separate models were examined for each discrete emotion. Results for the preceding models are not shown here: Model 1: intercept, skill acquisition, transition adaptation, reacquisition adaptation, quadratic skill acquisition, and quadratic reacquisition adaptation; Model 2: added ACT, sex, and videogame experience; Model 3: added general dimension affect at the between- and within-person levels of analysis (positive or negative). Level 1 accounted for autocorrelation in error structures (AR1). Using the AIC, bolded font indicates improved model fit using the AIC compared to the model with the general dimension—i.e., support for the incremental prediction of the respective discrete emotion.
N between-person = 467; *N* within-person = 6,538. **p* < .05, ***p* < .01.

Table 7

Study 1: Discontinuous Mixed–Effects Growth Models of Performance Change as a Function of Negative Emotions

Variable	*r*	Model 4 *B*	*SE*	*t*
Activating				
Angry (Between-person)	–.39**	**0.83**	**0.40**	**2.06***
Angry (Within-person)		**–0.65**	**0.09**	**–7.30****
Anxious (Between-person)	–.35**	**0.95**	**0.36**	**2.65****
Anxious (Within-person)		**0.24**	**0.08**	**2.85****
Frustrated (Between-person)	–.50**	–0.38	0.52	–0.72
Frustrated (Within-person)		**–0.69**	**0.08**	**–8.78****
Irritated (Between-person)	–.50**	–0.61	0.51	–1.19
Irritated (Within-person)		**–0.52**	**0.08**	**–6.82****
Tense (Between-person)	–.33**	**1.63**	**0.36**	**4.47****
Tense (Within-person)		**0.29**	**0.08**	**3.85****
Uneasy (Between-person)	–.43**	–0.27	0.41	–0.66
Uneasy (Within-person)		0.09	0.08	1.20
Deactivating				
Bored (Between-person)	–.40**	**–1.31**	**0.23**	**–5.73****
Bored (Within-person)		**–0.43**	**0.07**	**–6.53****
Disappointed (Between-person)	–.45**	–0.66	0.44	–1.49
Disappointed (Within-person)		**–0.37**	**0.08**	**–4.68****
Discouraged (Between-person)	–.48**	–0.53	0.46	–1.15
Discouraged (Within-person)		**–0.42**	**0.09**	**–4.85****
Fatigued (Between-person)	–.36**	–0.41	0.25	–1.66†
Fatigued (Within-person)		**–0.15**	**0.07**	**–2.10***

Note. Separate models were examined for each discrete emotion. Results for the preceding models are not shown here: Model 1: intercept, skill acquisition, transition adaptation, reacquisition adaptation, quadratic skill acquisition, and quadratic reacquisition adaptation; Model 2: added ACT, sex, and videogame experience; Model 3: added general dimension affect at the between- and within-person levels of analysis (positive or negative). Level 1 accounted for autocorrelation in error structures (AR1). Using the AIC, bolded font indicates improved model fit using the AIC compared to the model with the general dimension—i.e., support for the incremental prediction of the respective discrete emotion. *N* between-person = 467; *N* within-person = 6,538. †$p < .10$, *$p < .05$, **$p < .01$.

Table 8

Study 2: Descriptive Statistics and Correlations for Positive Emotions and Performance

Variable	*M*	*SD*	1	2	3	4
1. ACT	25.94	3.86				
2. Videogame experience	–0.15	0.71	.38*	(.73)		
3. Positive activating emotions[1]	4.11	1.24	–.04	.18	(.84)	
4. Positive deactivating emotions[1]	4.32	1.48	–.08	.11	.34*	(.85)
5. Performance[1]	28.09	11.03	.42**	.47**	.31*	–.01

Note. Diagonal values are internal consistencies. [1]Average score across all sessions (Sessions 1–14). $N = 54$. †$p < .10$, *$p < .05$, **$p < .01$

Table 9

Study 2: Model Building for the Discontinuous Growth Models of Performance Change as a Function of Emotion Control Group

	Step 1	Step 2	Step 3	Step 4	Step 5
Intercept, γ_{00}	X				
Skill acquisition, γ_{10}	X				
Transition adaptation, γ_{20}	X				
Reacquisition adaptation, γ_{30}	X				
Quadratic skill acquisition, γ_{40}	X				
Quadratic reacquisition adaptation, γ_{50}	X				
ACT, γ_{01}		X			
Videogame experience (VGE), γ_{02}		X			
Emotion control DC, γ_{03}			X		
Emotion control DC × Skill acquisition, γ_{13}				X	
Emotion control DC × Transition adaptation, γ_{23}					X
Emotion control DC × Reacquisition adaptation, γ_{33}					X

Note: DC: positive deactivating emotion control = 1, positive activating emotional control = –0.5, and no emotion control = –0.5. Step 3 in the model building above was used for testing Hypotheses 1 and 2, whereas Steps 4 and 5 were used to explore interactions involving the emotional control manipulation and skill acquisition, transition adaptation, and reacquisition adaptation.

Table 10

Study 2: Discontinuous Growth Models of Performance Change

Variable	Model 1 *B*	Model 1 *SE*	Model 1 *t*	Model 2 *B*	Model 2 *SE*	Model 2 *t*
Intercept, γ_{00}	24.89**	1.56	15.92	24.90**	1.39	17.87
Skill acquisition, γ_{10}	3.76**	0.80	4.72	3.76**	0.79	4.75
Transition adaptation, γ_{20}	–15.80**	1.76	–8.96	–15.32**	1.66	–9.23
Reacquisition adaptation, γ_{30}	–2.57*	1.11	–2.32	–3.13**	0.81	–3.84
Quadratic skill acquisition, γ_{40}	–0.36**	0.13	–2.89	–0.36**	0.12	–2.91
Quadratic reacquisition adaptation, γ_{50}	–0.09	0.13	–0.74			
ACT, γ_{01}				0.80*	0.31	2.54
Videogame experience (VGE), γ_{02}				3.87*	1.71	2.26
AIC		*5576.375*			*5558.918*	

Note. Level 1 accounted for autocorrelation (AR1) in error structures.
N between–person = 54; *N* within–person = 756. †$p < .10$, *$p < .05$, **$p < .01$.

Table 11

Study 2: Discontinuous Growth Models of Performance Change as a Function of Emotion Control Group

	Model 3			Model 4			Model 5		
Variable	*B*	*SE*	*t*	*B*	*SE*	*t*	*B*	*SE*	*t*
Emotion control DC, γ_{03}	3.44*	1.54	2.24	2.12	1.69	1.25	2.79	1.76	1.59
Emotion control DC × Skill acquisition, γ_{13}				0.24†	0.13	1.86	0.19	0.37	0.51
Emotion control DC × Transition adaptation, γ_{23}							–1.87	2.33	–0.80
Emotion control DC × Reacquisition adaptation, γ_{33}							0.51	0.47	1.08
AIC	*5553.830*			*5554.78*			*5552.593*		

Note. Level 1 accounted for autocorrelation (AR1) in error structures. DC: positive deactivating emotion control = 1, positive activating emotional control = –0.5, and no emotion control = –0.5.
N between–person = 54; *N* within–person = 756. †p < .10, *p < .05, **p < .01.

Table 12

Study 2: Model Building for the Discontinuous Growth Models of Emotion Scores and Performance

	Step 1	Step 2	Step 3	Step 4	Step 5
Intercept, γ_{00}	X				
Skill acquisition, γ_{10}	X				
Transition adaptation, γ_{20}	X				
Reacquisition adaptation, γ_{30}	X				
Quadratic skill acquisition, γ_{40}	X				
Quadratic reacquisition adaptation, γ_{50}	X				
ACT, γ_{01}		X			
Videogame experience (VGE), γ_{02}		X			
Positive activating emotions, γ_{03}			X		
Positive deactivating emotions, γ_{04}			X		
Positive activating emotions × Skill acquisition, γ_{13}				X	
Positive deactivating emotions × Skill acquisition, γ_{14}				X	
Positive activating emotions × Transition adaptation, γ_{23}					X
Positive activating emotions × Reacquisition adaptation, γ_{33}					X
Positive deactivating emotions × Transition adaptation, γ_{24}					X
Positive deactivating emotions × Reacquisition adaptation, γ_{34}					X

Note: Step 3 in the model building above was used for testing Hypotheses 5 and 6, whereas Steps 4 and 5 were used to explore interactions involving emotions and skill acquisition, transition adaptation, and reacquisition adaptation.

Table 13

Study 2: Discontinuous Growth Models of Performance Change as a Function of Emotion Scores and Performance

	Model 3			Model 4			Model 5		
Variable	***B***	***SE***	***t***	*B*	*SE*	*t*	*B*	*SE*	*t*
Positive activating emotions, γ_{03}	**2.73****	**0.91**	**3.00**	2.48**	1.00	2.47	2.36*	1.06	2.22
Positive deactivating emotions, γ_{04}	**–1.60***	**0.75**	**–2.13**	–1.63†	0.83	–1.96	–1.39	0.88	–1.58
Positive activating emotions × Skill acquisition, γ_{13}				0.05	0.08	0.62	0.12	0.22	0.55
Positive deactivating emotions × Skill acquisition, γ_{14}				0.01	0.07	0.08	0.26	0.19	1.37
Positive activating emotions × Transition adaptation, γ_{23}							–0.01	1.44	–0.01
Positive activating emotions × Reacquisition adaptation, γ_{33}							–0.16	0.29	–0.55
Positive deactivating emotions × Transition adaptation, γ_{24}							–1.68	1.21	–1.39
Positive deactivating emotions × Reacquisition adaptation, γ_{34}							–0.20	0.25	–0.83
AIC	***5550.074***			*5560.472*			*5562.532*		

Note. Level 1 accounted for autocorrelation (AR1) in error structures. Bolded results reflect those for the best–fitting model according to the AIC.
N between-person = 54; *N* within-person = 756. †p < .10, *p < .05, **p < .01.

Table 14

Study 2: Themes and sub-themes identified in open-ended responses

Theme and sub-themes
1. Learning
2. Performance
3. Emotion regulation
a. Up-regulating and/or maintaining positive activating emotions
b. Up-regulating and/or maintaining positive deactivating emotions
c. Down-regulating negative emotions
4. Cognitive processes
a. Improving focus
b. Improving retention/recall
5. Motivation
a. Drive
b. Persistence
c. Confidence
d. Enjoyment
e. Competition
6. Frame of reference

Note: Bolded font indicates those themes and sub-themes that showed statistically significant differences between the emotion control conditions when conducting the chi-square and Fisher's exact tests, whereas those in italicized fonts showed higher frequencies but the differences were not statistically significant.

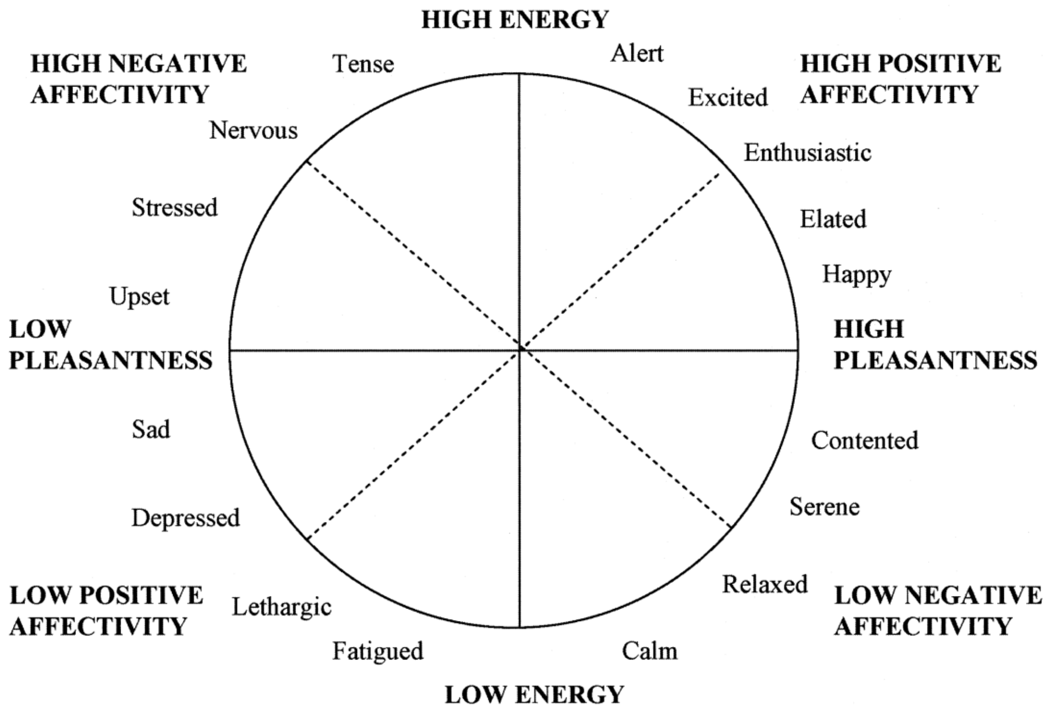

Figure 1. Dimensional models of affect with the positive and negative affect dimensions along the dotted lines and the valence (pleasantness) and arousal (energy) dimensions along the straight lines. From "Why does affect matter in organizations?" by S. G. Barsade & D. E. Gibson, 2007, *Academy of Management Perspectives*, 21, p. 39. Copyright 2007 by the Academy of Management. Published with permission.

Valence

Activation Potential		Positive	Negative
	Low	• At Ease • Calm • Relaxed	• Bored • Discouraged • Disappointed • Fatigued
	High	• Enthusiastic • Excited • Happy	• Angry • Anxious • Frustrated • Irritated • Tense • Uneasy

Figure 2. Study 1: Emotions measured in the present study clustered based on activation potential and valence.

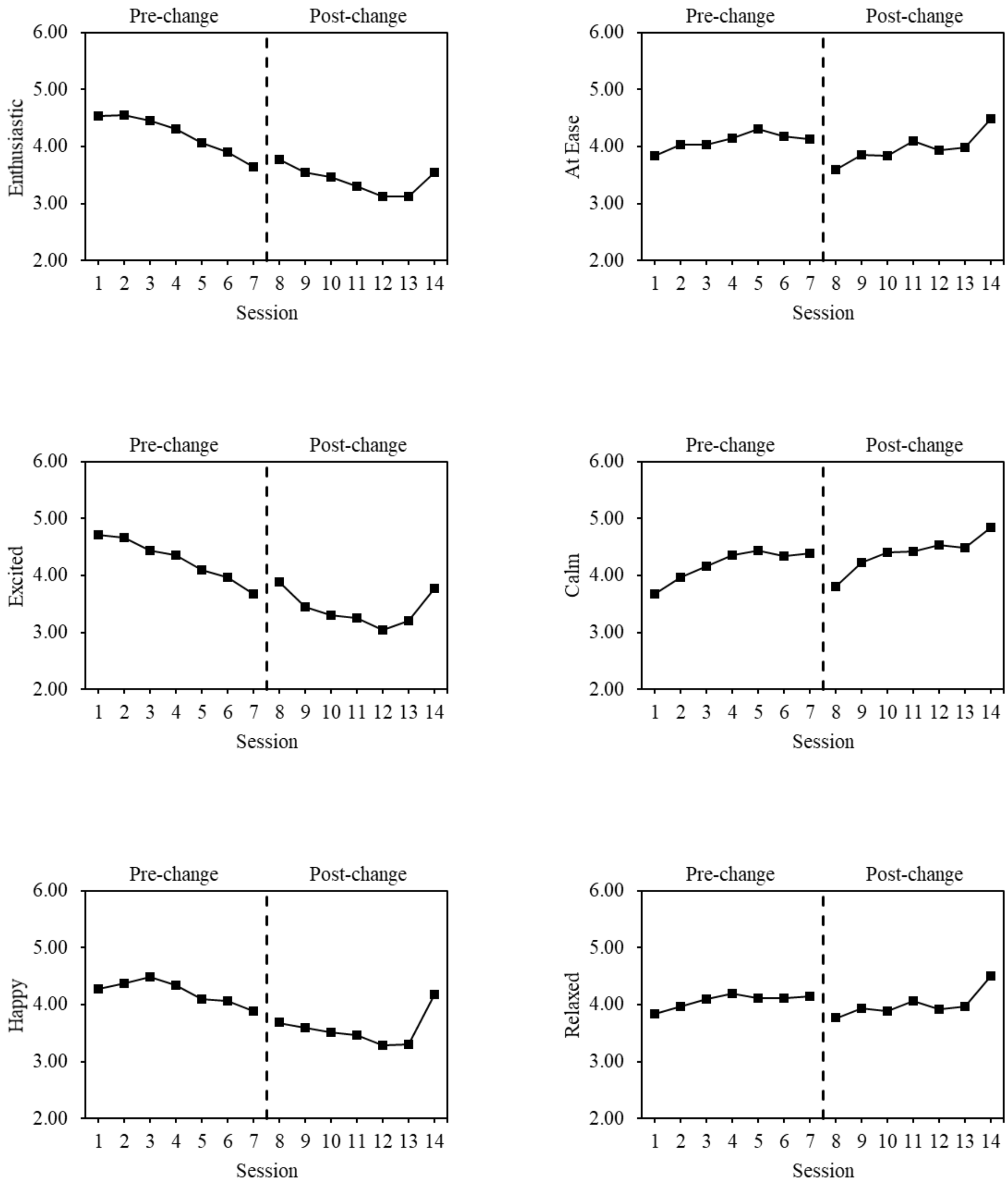

Figure 3. Study 1: Trends in study variables over the course of the 14 sessions: 1-7 = pre-change; 8-14 = post-change.

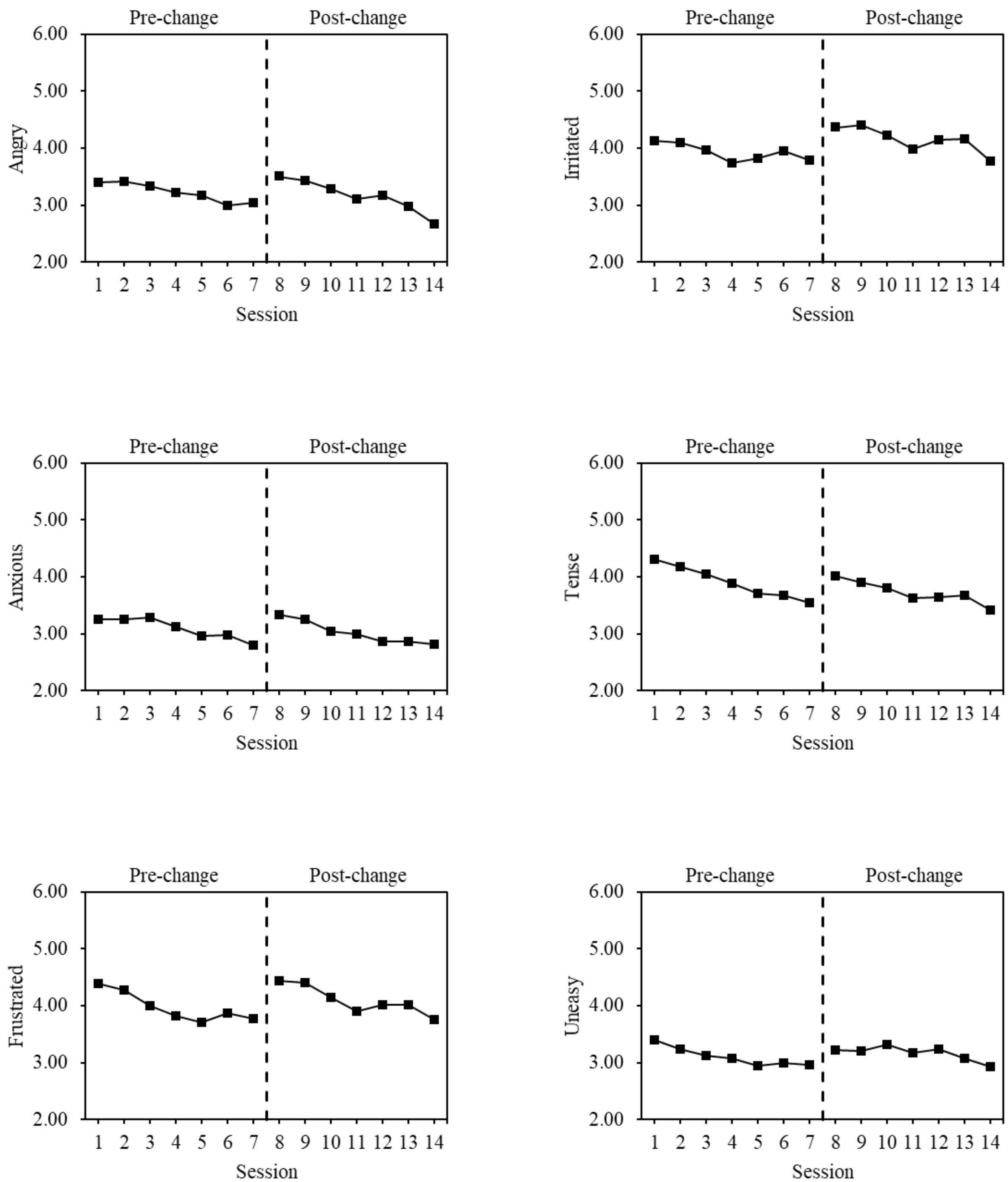

Figure 3. Study 1: Trends in study variables over the course of the 14 sessions: 1-7 = pre-change; 8-14 = post-change.

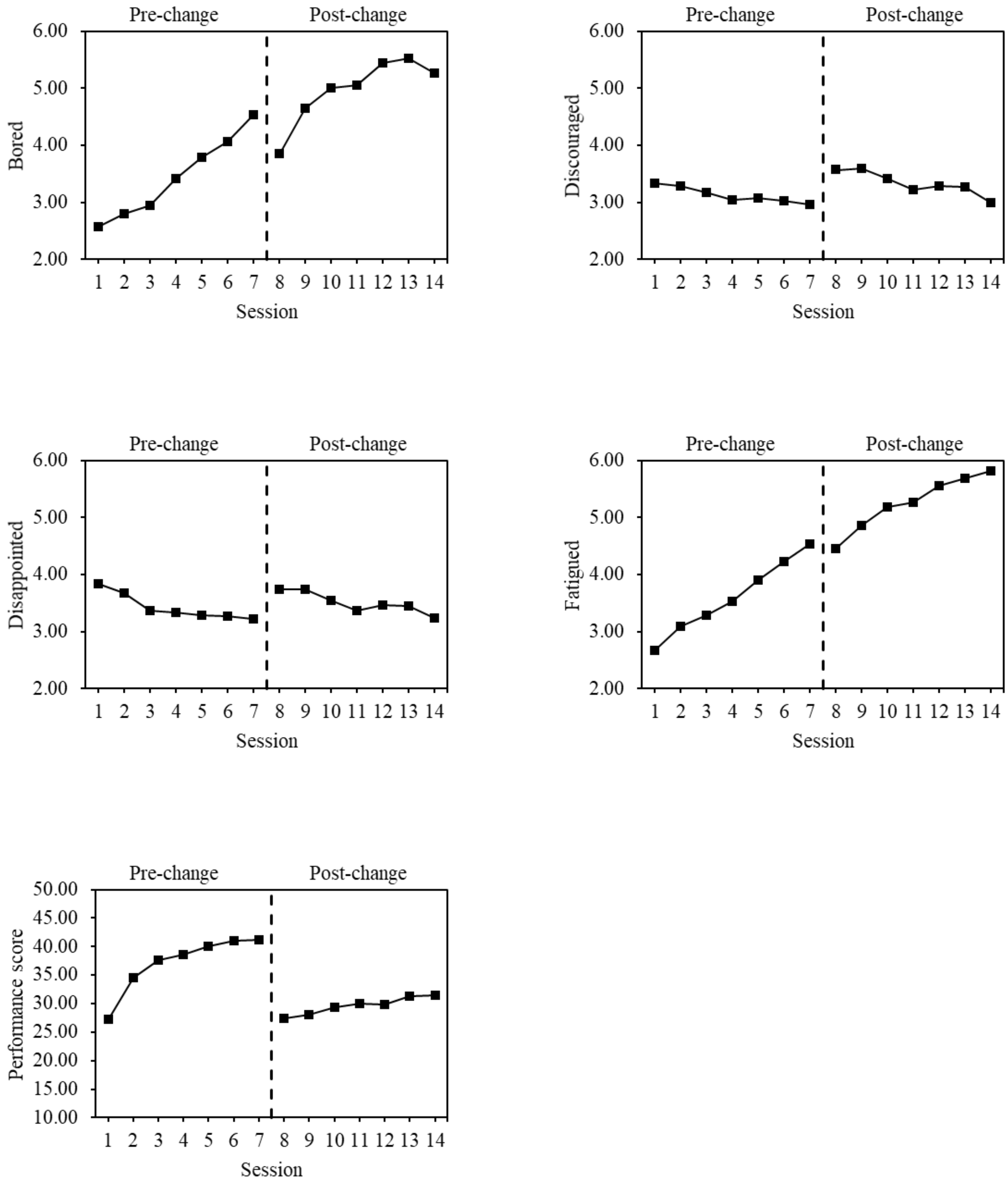

Figure 3. Study 1: Trends in study variables over the course of the 14 sessions: 1-7 = pre-change; 8-14 = post-change.

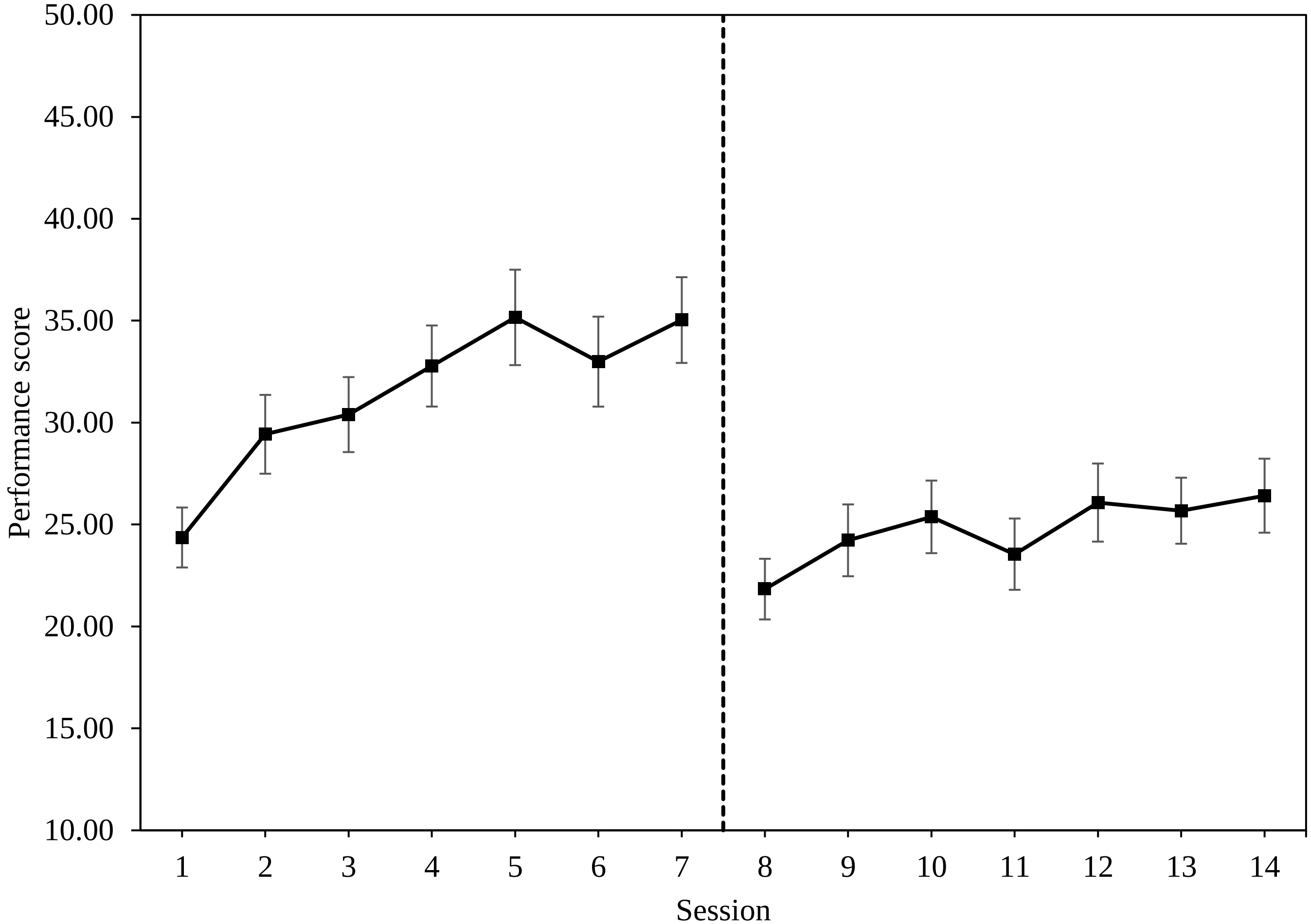

Figure 4. Study 2: Raw means for performance. Sessions: 1-7 = pre-change; 8-14 = post-change. Error bars = ± 1 SE.

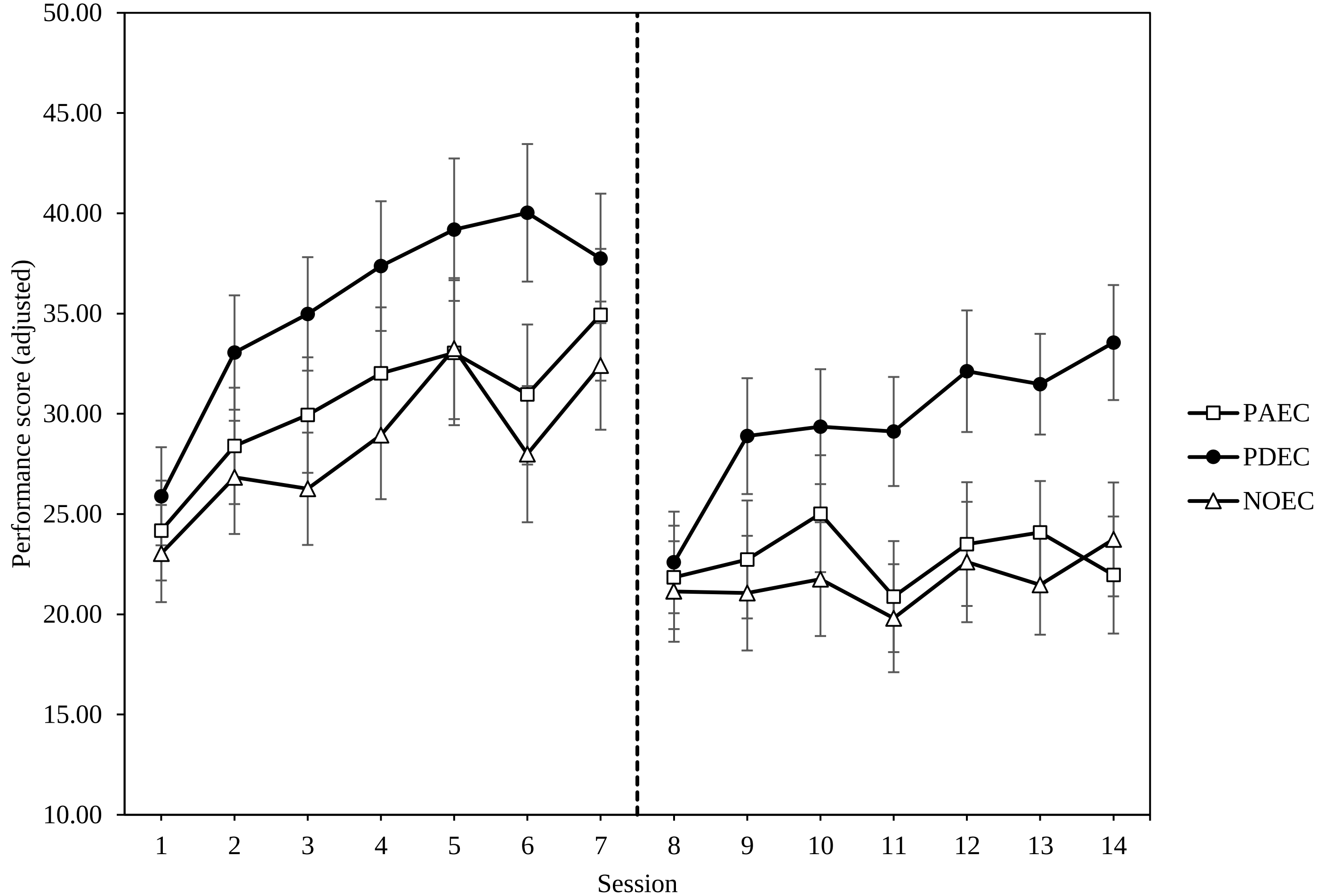

Figure 5. Study 2: Adjusted means of performance by condition, controlling for ACT scores and videogame experience. Sessions: 1-7 = pre-change; 8-14 = post-change. PAEC = positive activating emotion control, PDEC = positive deactivating emotion control, NOEC = no emotion control. Error bars = ± 1 SE.

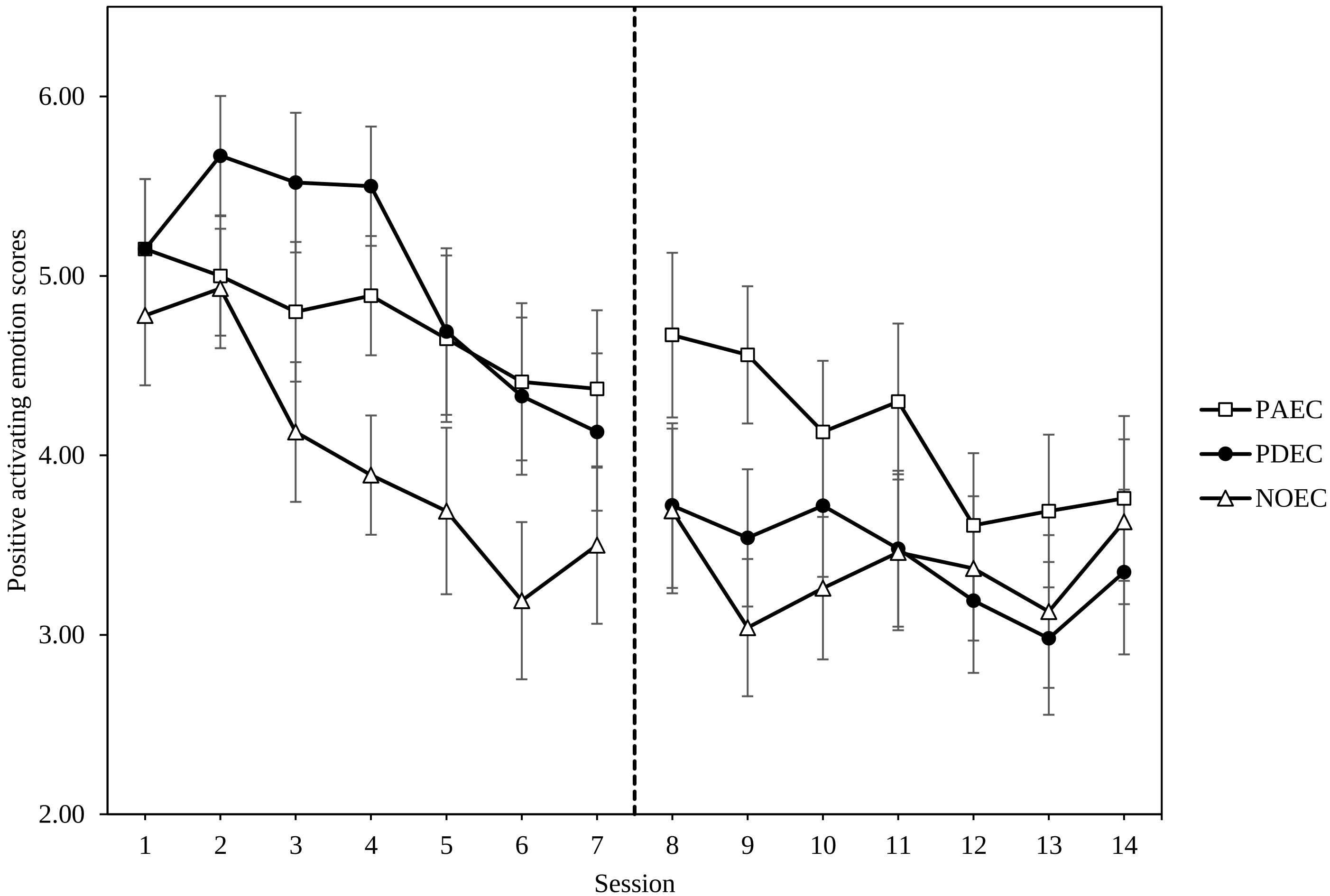

Figure 6. Study 2: Means of positive activating emotion scores by condition. Sessions: 1-7 = pre-change; 8-14 = post-change. PAEC = positive activating emotion control, PDEC = positive deactivating emotion control, NOEC = no emotion control. Error bars = ± 1 SE.

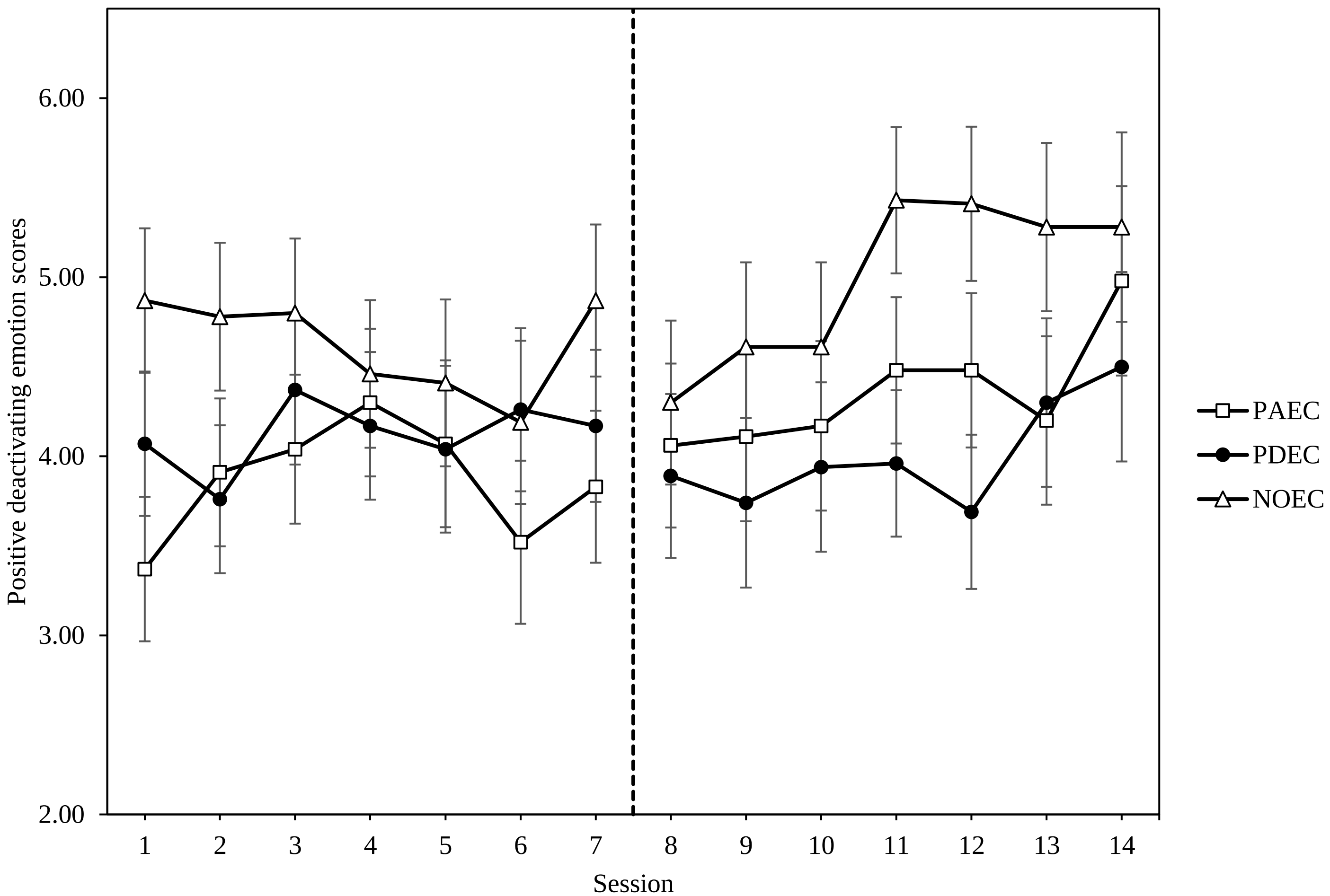

Figure 7. Study 2: Means of positive deactivating emotion scores by condition. Sessions: 1-7 = pre-change; 8-14 = post-change. PAEC = positive activating emotion control, PDEC = positive deactivating emotion control, NOEC = no emotion control. Error bars = ± 1 SE.

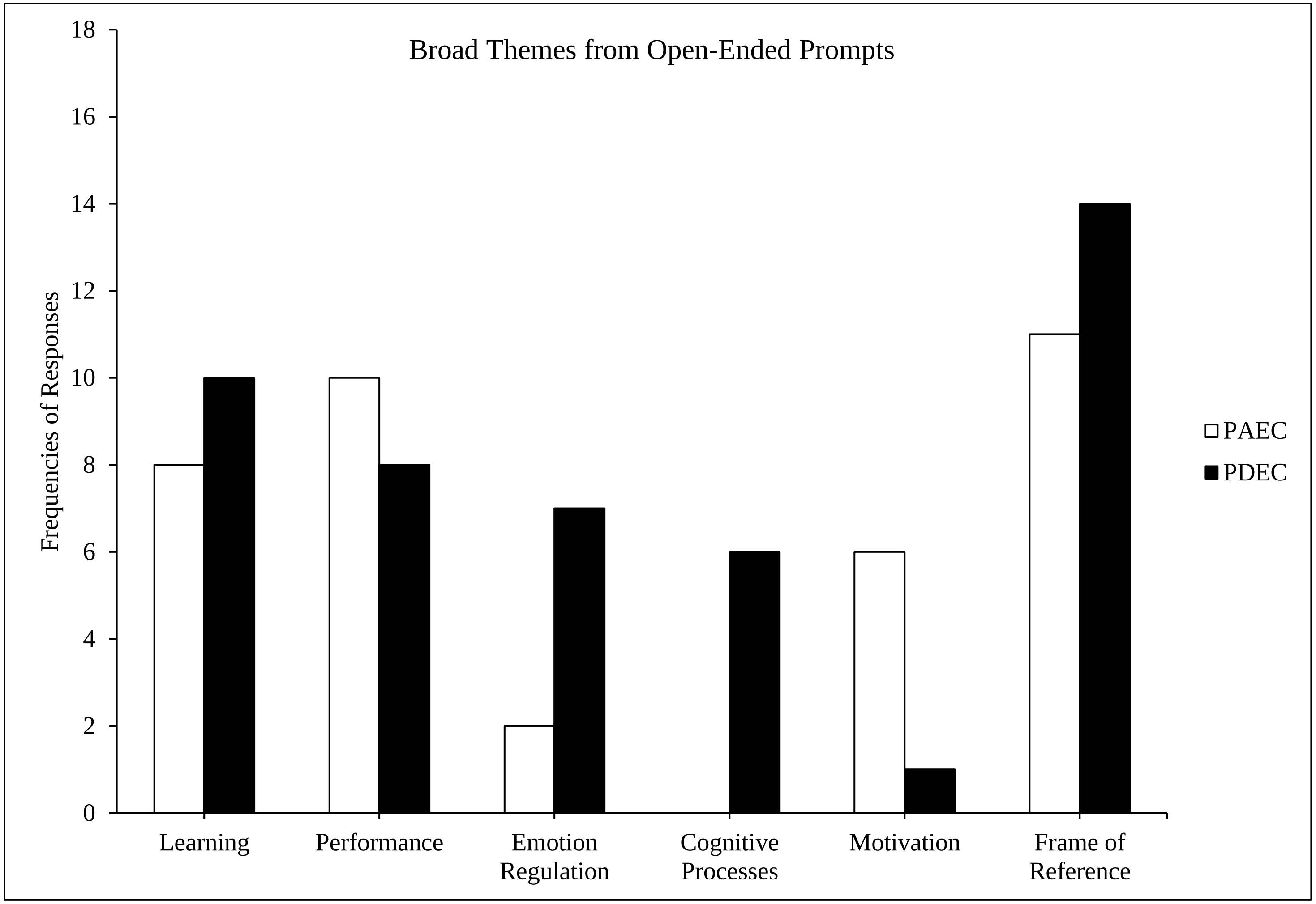

Figure 8. Study 2: Comparison of the number of times the broad themes appeared in the responses of those in the positive activating condition compared to the positive deactivating condition.

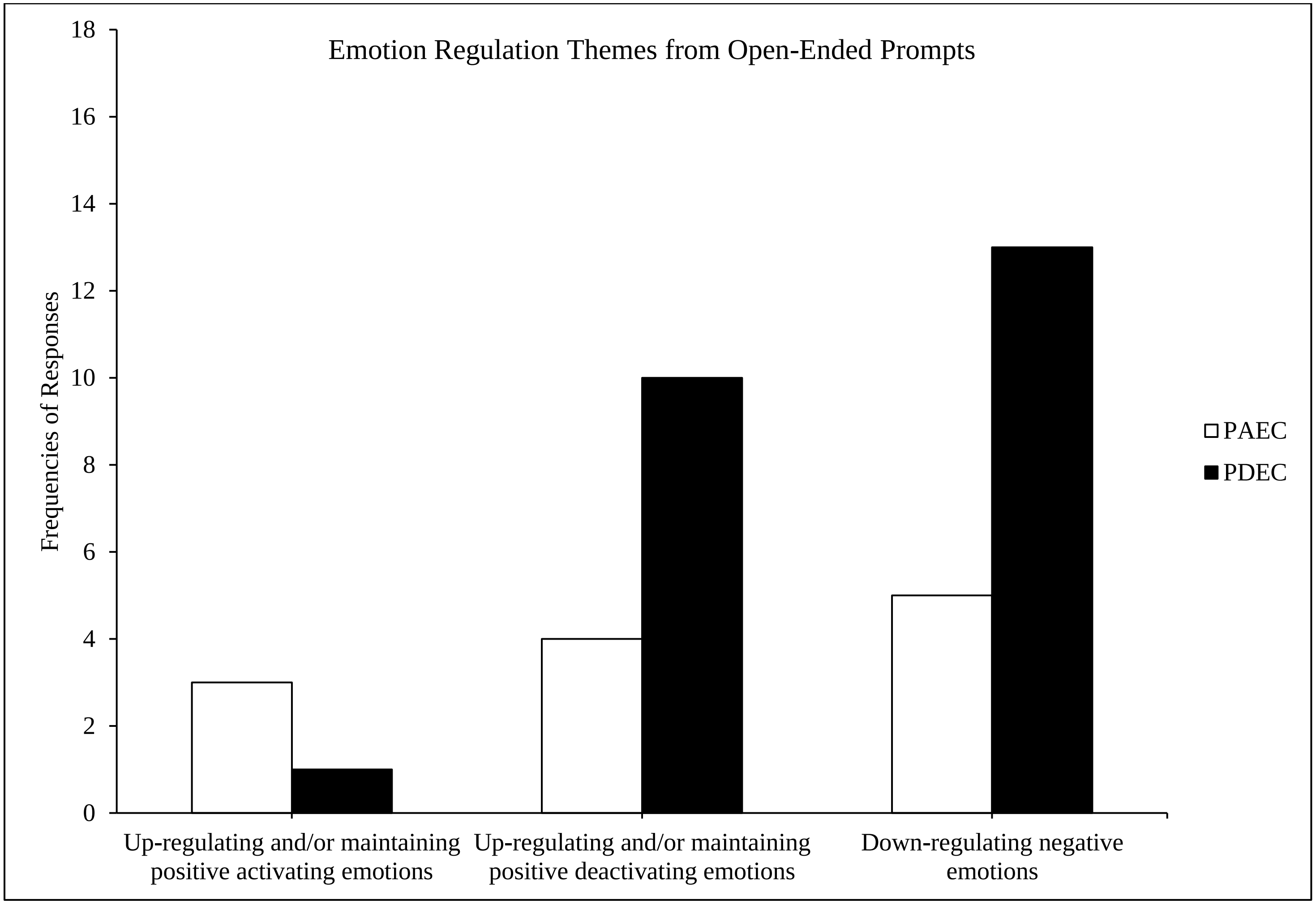

Figure 9. Study 2: Comparison of the number of times the emotion regulation sub-themes appeared in the responses of those in the positive activating condition compared to the positive deactivating condition.

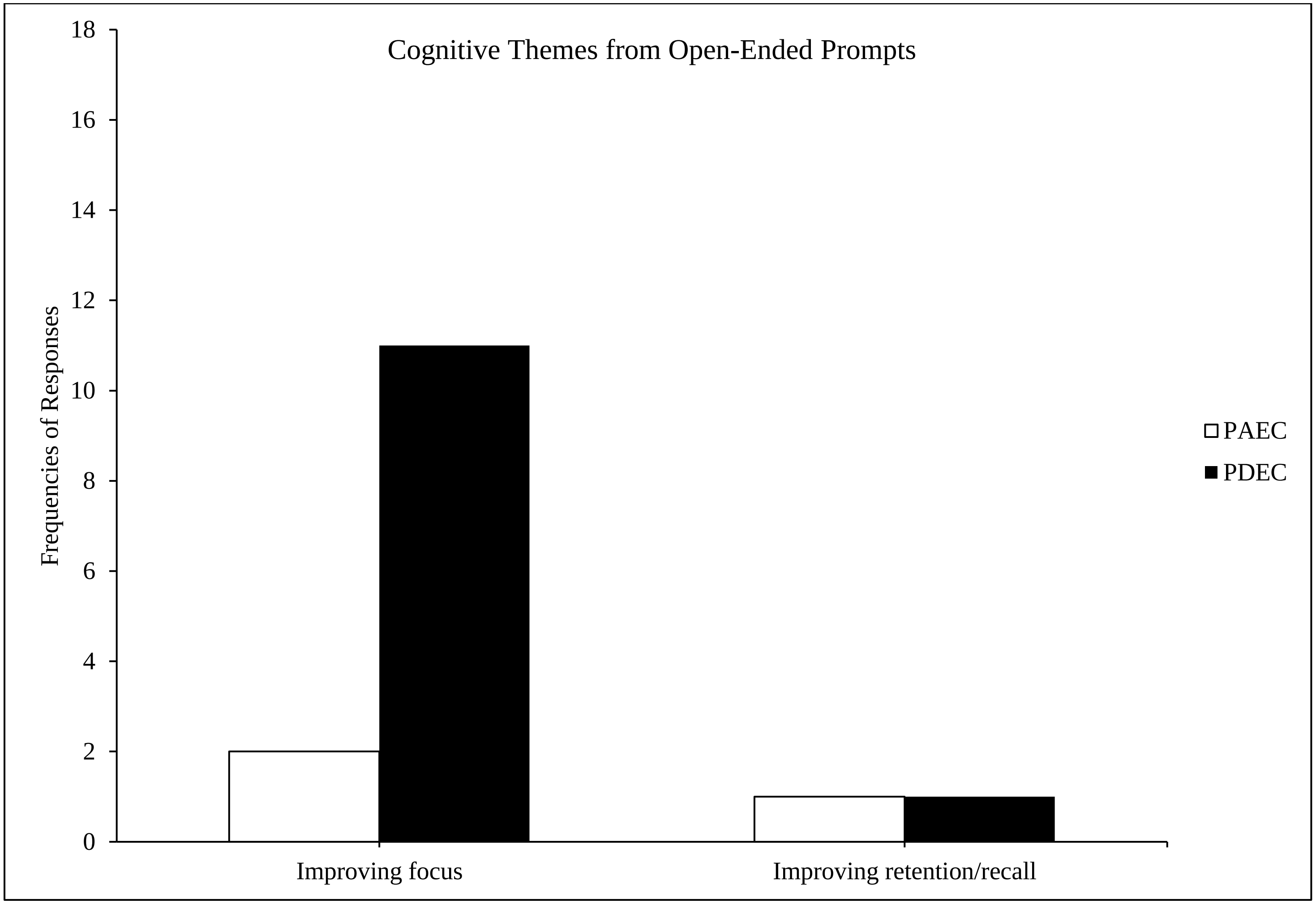

Figure 10. Study 2: Comparison of the number of times the cognitive processes sub-themes appeared in the responses of those in the positive activating condition compared to the positive deactivating condition.

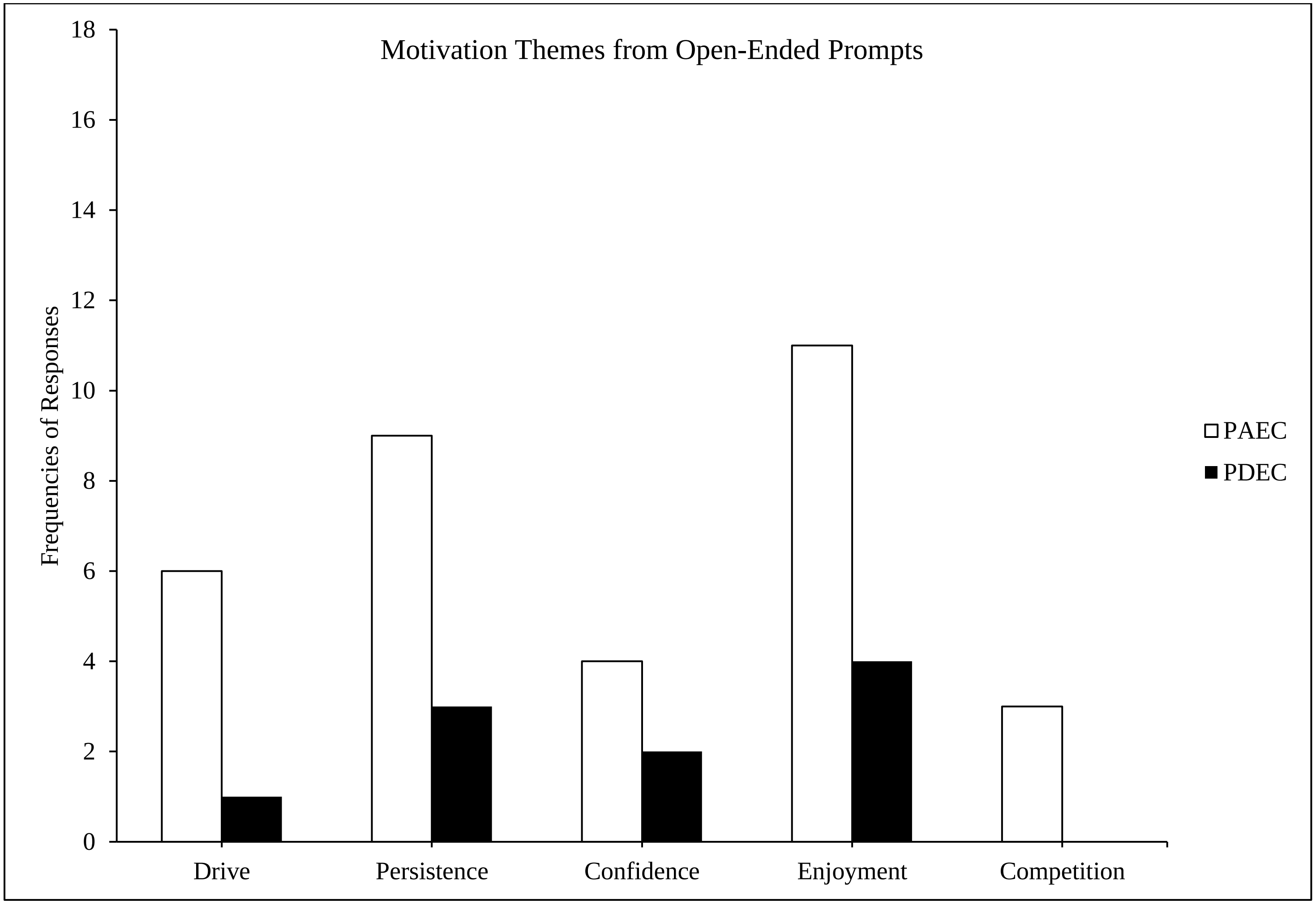

Figure 11. Study 2: Comparison of the number of times the motivation sub-themes appeared in the responses of those in the positive activating condition compared to the positive deactivating condition.

Appendix A

Study 1: Incremental Effects for Positive Emotions Using Hierarchical Regression Analyses

Variable	*r*	*B*	*SE*	*t*	ΔR^2
Positive Affect					
Pre-Change	.53**				——
Post-Change	.39**				——
Activating					
Enthusiastic					
Pre-Change	.50**	**1.67**	**0.52**	**3.19****	**.010****
Post-Change	.42**	**2.07**	**0.49**	**4.23****	**.020****
Excited					
Pre-Change	.48**	**1.52**	**0.45**	**3.37****	**.011****
Post-Change	.43**	**2.05**	**0.45**	**4.57****	**.024****
Happy					
Pre-Change	.53**	**2.11**	**0.60**	**3.50****	**.011****
Post-Change	.42**	**1.65**	**0.57**	**2.89****	**.010****
Deactivating					
At Ease					
Pre-Change	.39**	–0.71	0.54	–1.31	.002
Post-Change	.23**	–0.78	0.49	–1.59	.003
Calm					
Pre-Change	.32**	**–0.97**	**0.48**	**–2.00***	**.004***
Post-Change	.16**	**–1.34**	**0.43**	**–3.11****	**.011****
Relaxed					
Pre-Change	.39**	–0.58	0.53	–1.09	.001
Post-Change	.21**	**–1.38**	**0.51**	**–2.68****	**.008****

Note. Incremental prediction beyond sex, ACT scores, videogame experience, and the positive affect dimension. Bolded font indicates support for the incremental prediction of the respective discrete emotion. $N = 467$. †$p < .10$, *$p < .05$, **$p < .01$.

Appendix B

Study 1: Incremental Effects for Negative Emotions Using Hierarchical Regression Analyses

Variable	*r*	*B*	*SE*	*t*	ΔR^2
Negative Affect					
Pre-Change	–.53**				——
Post-Change	–.39**				——
Activating					
Angry					
Pre-Change	–.39**	0.25	0.58	0.44	.000
Post-Change	–.26**	**1.03**	**0.49**	**2.08***	**.005***
Anxious					
Pre-Change	–.37**	0.33	0.49	0.68	.000
Post-Change	–.23**	**1.12**	**0.46**	**2.41***	.007*
Frustrated					
Pre-Change	–.50**	–0.31	0.73	–0.42	.000
Post-Change	–.36**	–0.19	0.62	–0.30	.000
Irritated					
Pre-Change	–.48**	–0.15	0.71	–0.21	.000
Post-Change	–.37**	–0.74	0.60	–1.23	.002
Tense					
Pre-Change	–.32**	**1.75**	**0.51**	**3.42****	**.010****
Post-Change	–.22**	**1.70**	**0.47**	**3.64****	**.015****
Uneasy					
Pre-Change	–.44**	–0.46	0.58	–0.79	.001
Post-Change	–.30**	–0.29	0.51	–0.58	.000
Deactivating					
Bored					
Pre-Change	–.34**	**–1.62**	**0.37**	**–4.32****	**.017****
Post-Change	–.38**	**–1.57**	**0.27**	**–5.73****	**.036****
Disappointed					
Pre-Change	–.45**	**–1.28**	**0.63**	**–2.04***	**.004***
Post-Change	–.33**	–0.15	0.53	–0.28	.000
Discouraged					
Pre-Change	–.50**	**–1.52**	**0.68**	**–2.24***	**.005***
Post-Change	–.34**	0.14	0.55	0.26	.000
Fatigued					
Pre-Change	–.33**	–0.19	0.39	–0.49	.000
Post-Change	–.26**	–0.32	0.31	–1.05	.001

Note. Incremental prediction beyond sex, ACT scores, videogame experience, and the negative affect dimension. Bolded font indicates support for the incremental prediction of the respective discrete emotion. $N = 467$. †$p < .10$, *$p < .05$, **$p < .01$.

Appendix C
Study 2: Protocol

<table>
<tr><th>Study Conditions / Study Procedures</th><th>Positive Activating Emotion Control</th><th>Positive Deactivating Emotion Control</th><th>No Emotion Control</th></tr>
<tr><td>Study Introduction & Control Measures</td><td colspan="3">Informed consent – 2 min
Introduction to study – 1.5 min
Demographic questionnaire and control measures – 7 min</td></tr>
<tr><td>Training & Practice</td><td colspan="3">Training PowerPoint Presentation – 15 min
Practice Trial – 1 min</td></tr>
<tr><td>Pre-training measures</td><td colspan="3">Motivation to learn – 0.5 min
Self-Efficacy – 2 min</td></tr>
<tr><td>Emotion Control Manipulation</td><td>Emotion control prompt and questions – 10 min</td><td>Emotion control prompt and questions – 10 min</td><td>No prompt or questions</td></tr>
<tr><td rowspan="2">Session 1</td><td colspan="3">Practice trials 1-2 – 4 min each

PANAS State Emotions (T1) – 1 min
On-Task Attention (T1) – 0.5 min
Perceptions of Novelty (T1) – 0.5 min</td></tr>
<tr><td>Emotion reminder – 0.25 min</td><td>Emotion reminder – 0.25 min</td><td>No reminder</td></tr>
<tr><td rowspan="2">Session 2</td><td colspan="3">Practice trials 3-4 – 4 min each

PANAS State Emotions (T2) – 1 min
On-Task Attention (T2) – 0.5 min
Perceptions of Novelty (T2) – 0.5 min
Self-Efficacy (T2) – 0.5 min</td></tr>
<tr><td>Emotion reminder – 0.25 min</td><td>Emotion reminder – 0.25 min</td><td>No reminder</td></tr>
<tr><td>Session 3</td><td colspan="3">Practice trials 5-6 – 4 min each

PANAS State Emotions (T3) – 1 min
On-Task Attention (T3) – 0.5 min
Perceptions of Novelty (T3) – 0.5 min</td></tr>
</table>

<table>
<tr><td></td><td>Emotion reminder – 0.25 min</td><td>Emotion reminder – 0.25 min</td><td>No reminder</td></tr>
<tr><td rowspan="2">Session 4</td><td colspan="3">Break
Practice trials 7-8 – 4 min each

PANAS State Emotions (T4) – 1 min
On-Task Attention (T4) – 0.5 min
Perceptions of Novelty (T4) – 0.5 min
Self-Efficacy (T4) – 0.5 min</td></tr>
<tr><td>Emotion reminder – 0.25 min</td><td>Emotion reminder – 0.25 min</td><td>No reminder</td></tr>
<tr><td rowspan="2">Session 5</td><td colspan="3">Practice trials 9-10 – 4 min each

PANAS State Emotions (T5) – 1 min
On-Task Attention (T5) – 0.5 min
Perceptions of Novelty (T5) – 0.5 min</td></tr>
<tr><td>Emotion reminder – 0.25 min</td><td>Emotion reminder – 0.25 min</td><td>No reminder</td></tr>
<tr><td rowspan="2">Session 6</td><td colspan="3">Practice trials 11-12 – 4 min each

PANAS State Emotions (T6) – 1 min
On-Task Attention (T6) – 0.5 min
Perceptions of Novelty (T6) – 0.5 min
Self-Efficacy (T6) – 0.5 min</td></tr>
<tr><td>Emotion reminder – 0.25 min</td><td>Emotion reminder – 0.25 min</td><td>No reminder</td></tr>
<tr><td rowspan="3">Session 7</td><td colspan="3">Practice trials 13-14 – 4 min each

PANAS State Emotions (T7) – 1 min
On-Task Attention (T7) – 0.5 min
Perceptions of Novelty (T7) – 0.5 min
Emotion control – 0.25 min
Unreal Tournament Enjoyment 1 (T7) – 0.5 min</td></tr>
<tr><td>Formative evaluation feedback and reactions – 8 min</td><td>Formative evaluation feedback and reactions – 8 min</td><td>No formative evaluation feedback and reactions</td></tr>
<tr><td>Emotion reminder – 0.25 min</td><td>Emotion reminder – 0.25 min</td><td>No reminder</td></tr>
<tr><td>Session 8</td><td colspan="3">Practice trials 15-16 – 4 min each

PANAS State Emotions (T8) – 1 min
On-Task Attention (T8) – 0.5 min
Perceptions of Novelty (T8) – 0.5 min</td></tr>
</table>

	Self-Efficacy (T8) – 0.5 min		
	Emotion reminder – 0.25 min	Emotion reminder – 0.25 min	No reminder
Session 9	Practice trials 17-18 – 4 min each PANAS State Emotions (T9) – 1 min On-Task Attention (T9) – 0.5 min Perceptions of Novelty (T9) – 0.5 min		
	Emotion reminder – 0.25 min	Emotion reminder – 0.25 min	No reminder
Session 10	Practice trials 19-20 – 4 min each PANAS State Emotions (T10) – 1 min On-Task Attention (T10) – 0.5 min Perceptions of Novelty (T10) – 0.5 min Self-Efficacy (T10) – 0.5 min		
	Emotion reminder – 0.25 min	Emotion reminder – 0.25 min	No reminder
Session 11	Break Practice trials 21-22 – 4 min each PANAS State Emotions (T11) – 1 min On-Task Attention (T11) – 0.5 min Perceptions of Novelty (T11) – 0.5 min Self-Efficacy (T11) – 0.5 min		
	Emotion reminder – 0.25 min	Emotion reminder – 0.25 min	No reminder
Session 12	Practice trials 23-24 – 4 min each PANAS State Emotions (T12) – 1 min On-Task Attention (T12) – 0.5 min Perceptions of Novelty (T12) – 0.5 min Self-Efficacy (T12) – 0.5 min		
	Emotion reminder – 0.25 min	Emotion reminder – 0.25 min	No reminder
Session 13	Practice trials 25-26 – 4 min each PANAS State Emotions (T13) – 1 min On-Task Attention (T13) – 0.5 min Perceptions of Novelty (T13) – 0.5 min Self-Efficacy (T13) – 0.5 min		

	Emotion reminder – 0.25 min	Emotion reminder – 0.25 min	No reminder
Session 14	Practice trials 27-28 – 4 min each PANAS State Emotions (T14) – 1 min On-Task Attention (T14) – 0.5 min Perceptions of Novelty (T14) – 0.5 min Self-Efficacy (T14) – 0.5 min Unreal Tournament Enjoyment 2 (T14) – 1 min Personality – 10 min		
	Emotion reminder – 0.25 min	Emotion reminder – 0.25 min	No reminder

Appendix D

Study 2: Emotion Control Prompt – Positive Activating Condition

Previous research has shown that learning Unreal Tournament is a struggle, as it is fast-paced and there is a lot to figure out. However, individuals are able to get better at playing the game and do improve over time.

Think about a time when you had to learn something new that was challenging, it was a struggle, and it didn't come easy, yet you felt **<u>excited</u>**, **<u>enthusiastic</u>**, and **<u>happy</u>**, but eventually you were able to learn, make progress, and improve. In what ways did feeling **<u>excited</u>**, **<u>enthusiastic</u>**, and **<u>happy</u>** contribute to your learning, help you make progress, and help you improve?

We would like to give you a couple minutes to think about this time and after that we will ask you to respond to a few questions about that time. Click "next" when you are ready to move on.

In a few sentences, describe the time that came to mind where you had to learn something new that was challenging, it was a struggle, and it didn't come easy, yet you felt **<u>excited</u>**, **<u>enthusiastic</u>**, and **<u>happy</u>**, but eventually you were able to learn, make progress, and improve.

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How did feeling **<u>excited</u>**, **<u>enthusiastic</u>**, and **<u>happy</u>** help you learn, make progress, and improve?

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How can feeling **<u>excited</u>**, **<u>enthusiastic</u>**, and **<u>happy</u>** be helpful in approaching your next games in Unreal Tournament?

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What strategies can you use to help you feel **<u>excited</u>**, **<u>enthusiastic</u>**, and **<u>happy</u>** in the upcoming games in Unreal Tournament?

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Appendix E
Study 2: Emotion Control Prompt – Positive Deactivating Condition

Previous research has shown that learning Unreal Tournament is a struggle, as it is fast-paced and there is a lot to figure out. However, individuals are able to get better at playing the game and do improve over time.

Think about a time when you had to learn something new that was challenging, it was a struggle, and it didn't come easy, yet you felt **at ease**, **calm**, and **relaxed**, but eventually you were able to learn, make progress, and improve. In what ways did feeling **at ease**, **calm**, and **relaxed** contribute to your learning, help you make progress, and help you improve?

We would like to give you a couple minutes to think about this time and after that we will ask you to respond to a few questions about that time. Click "next" when you are ready to move on.

In a few sentences, describe the time that came to mind where you had to learn something new that was challenging, it was a struggle, and it didn't come easy, yet you felt **at ease**, **calm**, and **relaxed**, but eventually you were able to learn, make progress, and improve.

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How did feeling **at ease**, **calm**, and **relaxed** help you learn, make progress, and improve?

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How can feeling **at ease**, **calm**, and **relaxed** be helpful in approaching your next games in Unreal Tournament?

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What strategies can you use to help you feel **at ease**, **calm**, and **relaxed** in the upcoming games in Unreal Tournament?

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Appendix F
Study 2: Emotion Control Reminders

Positive Activating Condition
Remember what strategies you can use to help you feel excited, enthusiastic, and happy in approaching your next games in Unreal Tournament.

Positive Deactivating Condition
Remember what strategies you can use to help you feel at ease, calm, and relaxed in approaching your next games in Unreal Tournament.