Emotion

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The Role of Emotions in Esports Performance

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Emotions that differ on the approach-avoidance dimension are thought to have different functions. Based on the motivational dimensional model of affect, we expected high-approach tendency (and not valence) to facilitate sports performance in a gaming context. Moreover, we expected the influence of high-approach emotions on performance to be mediated by higher levels of cognitive and physiological challenge as an approach-related response. To test these hypotheses, 241 men completed 5 matches of a soccer video game FIFA 19. Before each match, approach tendencies and valence were experimentally manipulated by showing films that elicit amusement, enthusiasm, sadness, anger, and neutral states. Approach tendency, challenge/threat evaluations, cardiovascular responses, and game scores were recorded. After watching enthusiastic and amusing videos, gamers displayed stronger approach tendencies, and, in turn, improved performance, compared to negative emotions and neutral conditions. Moreover, enthusiasm produced a stronger approach tendency and promoted better performance than amusement. Elicitation of unpleasant emotions (anger and sadness) had no effect on approach tendencies or gaming-outcomes relative to the neutral conditions. Across all conditions, gamers with higher levels of cognitive and cardiovascular challenge achieved higher scores. These findings indicate that in a gaming context performance is enhanced by pleasant emotions with high-approach tendencies.

Keywords: pleasant emotions, approach motivation, challenge and threat, enthusiasm, psychophysiology

Supplemental materials: http://dx.doi.org/10.1037/emo0000903.supp

How do preperformance emotions influence sports competition? Prior work has shown that pleasant emotions are often associated with higher levels of performance, whereas unpleasant emotions are often associated with lower levels of performance (Campo et al., 2019; Martinent & Ferrand, 2015; Rathschlag & Memmert, 2015; Uphill & Jones, 2007; Vast, Young, & Thomas, 2010). However, emotions are more than just pleasant or unpleasant states; they also often include a motivational tendency to approach or avoid a situation (Gable, & Harmon-Jones, 2010). Considering both dimensions of affect—valence and approach-avoidance tendencies - it is not yet clear which one is responsible for beneficial effects in sports performance. This is not an exhaustive list of affective dimensions that characterize emotional experience (e.g., arousal, attention, certainty, commitment, control, dominance, effort, fairness, identity, obstruction, safety, upswing; Cowen & Keltner, 2017). We start with valence because it is the most fundamental and well-studied aspect of the emotional experience, and we contrasted it with the motivational tendency that is a rather novel, and not fully explored dimension that might be critical in a performance context (Gable, & Harmon-Jones, 2010). In this investigation, we used the motivational dimensional model of affect (Gable, & Harmon-Jones, 2010) to test the relative contributions of emotions' approach tendency (low/high) and valence (pleasant/unpleasant) in the context of sports performance.

In particular, we focused on esports, which is a novel context for studying emotions and behavior. Esports is the fastest-growing area in the field of sports, in which individuals compete with one another using video games. Gamers are highly motivated individuals who regularly train to develop their skills and compete (Pedraza-Ramirez, Musculus, Raab, & Laborde, 2020). Esports involves psychological processes similar to sports such as accurate decision-making, creative thinking, and in-depth game-related knowledge (Pedraza-Ramirez et al., 2020). Moreover, the development of technology allows esports competition to be carried out entirely online without the need for physical contact between players (e.g., during the COVID-19 lockdown, esports remained one of the very few fully authorized forms of sports competition).

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Also, in esports, gamers compete in the seated position in front of the screen, which provides an excellent opportunity to examine psychophysiological responses related to performance in the laboratory settings, which are also ecologically valid. In summary, we focus on esports due to its novelty, extremely fast-growing popularity, and its compatibility with psychophysiological laboratory research.

Motivation and Emotion

Emotions are widely believed to help energize and direct behavior (Ekman, 1992; Frijda, 1986), but the precise nature of the differential motivational impact of various emotions is not yet clear. Recent work has demonstrated that high-approach emotions differ from low-approach emotions in several different ways, including their neural correlates (Harmon-Jones, Harmon-Jones, Fearn, Sigelman, & Johnson, 2008), their effects on cognition (Gable & Harmon-Jones, 2008), their peripheral physiology (Kaczmarek, Behnke, Kosakowski, et al., 2019; Qin, Lü, Hughes, & Kaczmarek, 2019), and their effects on behavior (Fawver, Hass, Park, & Janelle, 2014; Mouras, Lelard, Ahmaidi, Godefroy, & Krystkowiak, 2015).

However, despite the research on basic processes, the role of approach tendencies has been understudied in complex phenomena such as sports performance. Theoretical models propose that individuals should benefit from high-approach tendencies while attempting to acquire desired goals by shutting out irrelevant perceptions and cognitions (Gable & Harmon-Jones, 2010). Studies have shown that individuals perform better in cognitive tasks when they display strong approach tendencies under high time pressure (Friedman, & Förster, 2005; Roskes, Sligte, Shalvi, & De Dreu, 2011, 2013). However, it is not clear whether approach tendency or valence drove these effects because approach tendencies were induced with positive stimuli, whereas avoidance tendencies with negative stimuli (Friedman, & Förster, 2005; Roskes et al., 2011, 2013).

Blending pleasant and high-approach emotions is possible because motivational tendencies and valence are usually highly correlated, as seen by individuals being more likely to approach situations that elicit pleasant feelings and avoid situations that elicit unpleasant feelings (Cacioppo, Gardner, & Berntson, 1999; Marchewka, Żurawski, Jednorŏg, & Grabowska, 2014). However, this hedonic rule does not always apply. Experiencing anger, a generally unpleasant emotion, is related to high-approach tendency to face the stimuli and act to reduce its distressing influence (Carver & Harmon-Jones, 2009). Additionally, positive emotions also differ in terms of the intensity of approach motivational-tendency, such as enthusiasm being a high-approach emotion, whereas amusement or contentment are low-approach emotions (Gable & Harmon-Jones, 2008; Gable & Harmon-Jones, 2010).

Motivation, Emotion, and Sports Performance

Emotions are an integral part of sports performance (Hanin, 2012; Robazza, 2006; Uphill & Jones, 2007), but to date, few experimental studies examined how discrete emotions influence sports performance (Davis, Woodman, & Callow, 2010; Rathschlag & Memmert, 2013, 2015; Woodman et al., 2009) with the exception of anxiety (see Woodman & Hardy, 2003, for the review). The studies have shown that recall of happiness promoted better sprint performance in comparison to neutral and anxiety conditions (Rathschlag & Memmert, 2015). Recalled happiness and anger promoted better performances in strength and vertical jumping tests compared to neutral affect, anxiety, and sadness (Rathschlag & Memmert, 2013). Furthermore, individuals in imagery-evoked anger displayed greater gross muscular peak force when they were asked to kick as fast and as hard as possible in comparison to neutral and happiness conditions (Davis et al., 2010; Woodman et al., 2009). Additionally, cross-sectional studies have shown that experiencing pleasant and high-approach emotions such as excitement and happiness (Uphill, Groom, & Jones, 2014; Vast et al., 2010) were related to successful performance, whereas experiencing unpleasant and low-approach emotions such as anxiety and embarrassment were related to unsuccessful performance (Uphill et al., 2014; Vast et al., 2010; Woodman & Hardy, 2003).

Although promising, it is not clear what drives these effects. Research on sports performance has shown that athletes benefit from high-approach negative emotion (anger) and high-approach positive emotions (happiness, excitement) compared to low-approach negative emotions (i.e., anxiety and sadness; Rathschlag & Memmert, 2013, 2015). Based on those findings, the approach tendency may be the key element of successful performance. In this light, it is noteworthy that previous research on sports performance did not control for a range of approach tendencies that resulted from elicitated discrete emotions. This limits our inferences, because the anger that is generally associated with approach tendency (Harmon-Jones & Harmon-Jones, 2016) may also be associated with avoidance tendencies in the situations that are likely to coinduce anger and anxiety (Kaczmarek, Behnke, Enko, et al., 2019; Zinner, Brodish, Devine, & Harmon-Jones, 2008). Another limitation of these studies is that they did not compare multiple positive emotions; thus, it is not possible to determine if the beneficial effects of happiness were due to pleasant valence or approach tendency when compared to low-approach unpleasant emotions. Differentiation between high-approach and low-approach emotions is needed in order to understand the role of preperformance emotions in sports.

The Mediating Role of Challenge Responses

If high-approach emotions do, in fact, have beneficial effects on sports performance, what might explain these effects? One candidate mechanism is the challenge response, suggested by the biopsychosocial model of challenge and threat (Blascovich, 2008; Hase, O'Brien, et al., 2019; Seery, 2011). In the context of performance, the challenge response is characterized by high approach-motivation, namely by energization of behavior directed toward the desirable goal (Blascovich, 2008; Elliot & Thrash, 2002; Nicholls, Perry, & Calmeiro, 2014). Along with the high approach motivation, the challenge response is also characterized by physiological mobilization via increased blood flow throughout the body (i.e., increased cardiac output), which provides the efficiency of energy delivery required for successful performance (Blascovich, 2008; Seery, 2011). A final major component of the challenge response is the perception of the superiority of one's resources (e.g., skills, knowledge, and abilities) over the performance demands (e.g., opponents' skills, social expectations, and required effort). These motivational, physiological, and cognitive responses form a challenge response that is likely to facilitate the performance outcomes (Behnke & Kaczmarek, 2018; Behnke, Kosakowski, & Kaczmarek, 2020; Hase, O'Brien, et al., 2019; Wormwood et al., 2019). In sports specifically, the challenge responses should facilitate performance via improved decision making and cognitive functioning, stronger task engagement, and increased anaerobic power (see Jones, Meijen, McCarthy, & Sheffield, 2009; Meijen, Turner, Jones, Sheffield, & McCarthy, 2020, for the review).

Taken together, both the challenge state and high-approach emotions should lead to successful performance, due to shared characteristics, namely the energization of behavior directed toward the goal and increased cardiac efficiency (Jamieson, Hangen, Lee, & Yeager, 2018; Kreibig, 2010; Siegel et al., 2018). Due to increased approach tendency and increased cardiac efficiency elicited by high-approach emotions, individuals might be more likely to evaluate their coping resources as surpassing demands. Thus, high-approach emotions might facilitate the challenge response. However, the exact mechanism or mechanisms by which high-approach emotions activate challenge might be different given how much remains to be learned about the complex, multifaceted nature of emotions and their influence on behavior.

Although emotions are usually conceptualized as consequences of motivational challenge/threat states (Jones et al., 2009), we propose that emotions may also precede and activate the challenge/threat responses (Trotman, Williams, Quinton, & Veldhuijzen van Zanten, 2018). In this way, challenge/threat responses would be elicited by initial emotional response, reflecting the spiral cycle of emotion generation and emotion regulation (Gross, 2015).

The Present Research

The aim of the present research was to examine the effects of preperformance emotions on sports competition, with particular focus on esports. In our study, participants played the video game *FIFA,* which is the leading video game in the sports simulation category with 45 million unique console and PC gamers worldwide (Electronic Arts Inc., 2019). In studying emotions, we focused on amusement, enthusiasm, sadness, and anger to fill in four cells in a valence (pleasant/unpleasant) and approach (low/high) 2 × 2 matrix. We manipulated targeted emotions with film clips. Each participant played five matches; each match preceded by induction of one discrete emotion and a neutral control clip.

Building upon the theoretical models relevant to the study of emotion and performance (Blascovich, 2008; Gable & Harmon-Jones, 2010; Seery, 2011), we formulated hypotheses regarding the direct effects of emotions on performance (see Figure 1). We expected that motivational tendencies would drive the effects of emotions on performance rather than valence. In particular, we expected that high-approach emotions (anger and enthusiasm) would lead to better performance (Path A) compared to low-approach emotions (sadness and amusement) and neutral conditions (Path A′). Furthermore, we expected that high-approach emotions would elicit a stronger challenge response to the performance, as indexed by stronger approach motivational tendencies (Path B), increased cardiac efficiency (Path C), and stronger challenge-specific evaluations (Path D) compared to low-approach emotions and neutral conditions (Path B′, Path C′, Path D′). Finally, we expected that stronger challenge responses would lead to better performance, meaning that higher performance-related approach tendencies (Path E), higher cardiac efficiency (Path F), and stronger challenge evaluations (Path G) would be related to better performance.

Based on predicted direct effects (single path or single regression coefficient), we also formulated three mediational hypotheses regarding indirect effects (the product of two paths or regression coefficients). We expected that high-approach emotions would lead to better performance via higher performance-related approach tendencies (Path BE), higher cardiac efficiency (Path CF), and stronger challenge evaluations (Path DG). The inclusion of mediators often increases power relative to testing total effects only (Kenny & Judd, 2014; O'Rourke & MacKinnon, 2015). Thus, testing mediations decreases the odds of type II error when less pronounced effects are studied. Past research has shown that performance in the sports and gaming field depends greatly on

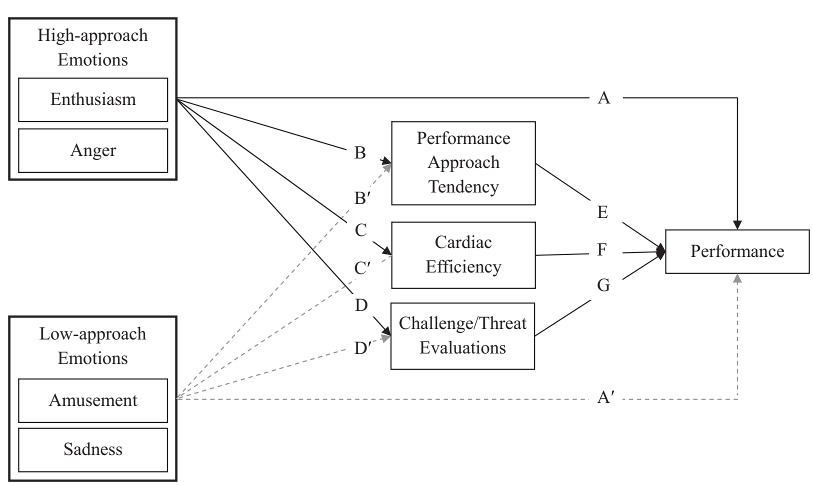

Figure 1. Proposed model for role of emotions in esports performance. We grouped high-approach and low-approach emotions to simplify the figure. We expected the relations in regard to each emotion separately.

skills and previous gaming experience (Behnke et al., 2020), however, psychological influences, such as emotions, are secondary factors that are expected to produce significant yet less pronounced effects.

Method

Participants

Participants were 241 male gamers between the ages of 18 and 37 years ($M = 23.63$, $SD = 3.63$). A power analysis using G*Power 3.1 (Faul, Erdfelder, Buchner, & Lang, 2009) indicated that detection of expected effect sizes of $f^2 = 0.10$ (Behnke & Kaczmarek, 2018), with the power of .90, would require a sample size of 217 participants, for a repeated measures design. We collected additional participants because we expected 10–15% of the sample to be lost due to recording problems in studies examining psychophysiological responses. We recruited gamers via a Facebook advertisement targeted at *FIFA 19*. Of the participants, 221 (92%) were recreational gamers, 19 (8%) were nonprofessional esports gamers (competing in local or online tournaments), and one (<1%) gamer did not report his status. Gamers had normal or corrected vision and no known history of cardiovascular or respiratory disease. Gamers' Body Mass Index (BMI) ranged from 16.85 and 35.55 kg/m^2 ($M = 24.55$, $SD = 3.19$). We asked participants to reschedule if they experienced illness or a major negative life event and to refrain from vigorous exercise, food, and caffeine for two hours before testing. We introduced the above restrictions to eliminate factors that might affect cardiovascular functions or usual gaming performance. Each participant provided written informed consent and received two vouchers for a cinema ticket for participation in the study. The institutional ethics committee approved the study.

Procedure

Participants were tested individually in a sound-attenuated and air-conditioned room. Upon arrival in the lab, participants provided informed consent, and the researcher applied sensors to obtain cardiovascular measurements. All instructions were presented, and responses were collected via a PC with a 23-in. screen. The experiment started with a 5-min baseline, during which we asked gamers to sit quietly. Next, participants completed five rounds consisting of: 1) two minutes of baseline; 2) watching a movie (emotion elicitation); 3) reporting discrete emotions they felt while watching the clip; 4) reporting challenge/threat evaluations; 5) playing the *FIFA 19* match. We operationalized the prefilm baseline as the indicator of a repeated resting state during the study.

To elicit emotion, we used stimuli from an emotion-eliciting video clip database, with prior evidence of reliability and validity (Gross & Levenson, 1995; Kaczmarek, Behnke, Enko, et al., 2019; Schaefer, Nils, Sanchez, & Philippot, 2010). We used validated movie clips: (a) "A fish called Wanda" for amusement (Archie gets undressed, waiting for his girlfriend. Unexpectedly, the owners of the house get into the house and discover him naked); (b) "American History X" for anger (a neo-nazi smashes a Black man's head on the curb and killing him); (c) Summer Olympic Games for enthusiasm (montage of moments showing athletes successful performance and their joyful reactions); (d) "The Champ" for sadness (a boy cries at the death of his father); (d) "Blue" for neutral (a man clears out the drawers of his desk, or a woman walks in an alley, greets another woman, and continues walking). Each clip lasted two minutes. The session clips were presented in a counterbalanced order. The presentation of five clips resulted in 120 unique sequences that were randomly assigned to participants so that each sequence was assigned to at least two participants.

Our aim was to test how emotions elicited in gamers before the performance influence their subsequent actions. Thus, participants reported emotions felt after viewing the video clips (i.e., right before they started to play the game). Respecting the temporal order of variables in a model is essential for meeting assumptions of mediation testing (MacKinnon, Fairchild, & Fritz, 2007). Moreover, preperformance self-reports predict the influence of challenge-type cardiac response on behavior better than retrospective self-reports (Trotman et al., 2018).

Participants played *FIFA 19* (Electronic Arts Inc., U.S.A.). In this game, individuals compete with the standard soccer rules. The team that scores more goals than their opponents wins the match. To standardize conditions across participants, in each match, participants competed in a *Classic Match* mode playing their favorite team against Real Madrid controlled by computer avatars (bots) set at the professional difficulty level. Each match lasted eight minutes (two 4-min halves). Upon completing the study, biosensors were removed, and the participants were debriefed.

Measures

Performance. We used the number of goals scored and lost during the match as the primary performance level indicator. Scoring more goals than the opponent is the final indicator of success in soccer. Thus, we subtracted lost goals from the scored goals, with a higher number indicating better performance. We also used several secondary indicators of successful soccer performance, such as the number of shots on target, takeovers, fouls, accuracy of shots and passes, ball possession time, with a higher number of them (except fouls) indicating better performance. These indicators reveal the advantage of one team over another. We operationalized them as secondary indicators because soccer is a strategic game in which there are many possible ways to defeat the opponent.

Approach/avoidance tendencies. While gaming, participants continuously reported whether they felt the urge to approach or avoid a situation with a Response Meter (ADInstruments, New Zealand), on a scale from 1 (*extreme avoidance tendency*) to 10 (*extreme approach tendency*). Previous research indicated that individuals are able to report the intensity of their urge to approach or withdraw from a stimulus using rating scales (Cowen & Keltner, 2017; Kaczmarek, Behnke, Kosakowski, et al., 2019; Marchewka et al., 2014). The ratings along the approach-avoidance dimension are relatively independent from ratings of valence and arousal. For instance, individuals report stronger approach tendency (but the same levels of valence and arousal) toward luxury goods or attractive individuals than toward happy elderly or unattractive individuals (Kaczmarek, Behnke, Kosakowski, et al., 2019). Players were instructed and regularly prompted to adjust the scale whenever they experienced a substantial change in their approach-avoidance motivation. This was particularly feasible in moments when the gameplay was naturally halted due to a gaming event, and players were able to remove their hand from the gamepad (e.g., when the ball went out of the field, during player substitutions, after fouls and goals). Players were also free to pause the game and adjust the scale. Furthermore, we provided a validated approach-avoidance graphical scale modeled after the self-assessment manikin above the numeric scale. Graphical stickman was modeled based on previous research indicating that approach motivational tendency is related to leaning forward and reaching for an object whereas avoidance is related to moving away and reclining backward (Harmon-Jones, Harmon-Jones, & Price, 2013; Harmon-Jones, Gable, & Price, 2011). The signal was sampled at a rate of 1000 Hz by Powerlab 16/35 (ADInstruments, New Zealand) and further processed using LabChart 8.19 software (ADInstruments, New Zealand). Electronic rating scales collect reliable and valid emotion ratings (Ruef & Levenson, 2007).

Challenge/threat evaluation. We conceptualized challenge and threat evaluations as the difference in perceived resources and demands (Tomaka, Blascovich, Kelsey, & Leitten, 1993; Seery, 2011). Situational demands were assessed by asking, “How demanding do you expect the upcoming game to be?” while gamers' resources were measured by asking, “How able are you to cope with the demands of the game?”. Participants used a 7-point scale ranging from 1 (*not at all*) to 7 (*extremely*). This measurement method of demands and resources has been used in research on cognitive evaluations, cardiovascular responses, and sports performance (Hase, Hood, et al., 2019; Moore, Vine, Wilson, & Freeman, 2012, 2014). After subtracting demands for winning the match from gaming resources, the evaluation score ranged from −6 to + 6 with positive scores reflecting high challenge and negative scores reflecting high threat.

Challenge/threat cardiovascular response. Cardiovascular biosignals were recorded continuously and noninvasively with the Vrije Universiteit Ambulatory Monitoring System (VU-AMS, the Netherlands) following psychophysiological guidelines (Sherwood et al., 1990; van Lien, Neijts, Willemsen, & de Geus, 2015). Impedance cardiography (ICG) and electrocardiography (ECG) recordings provided continuous measures of cardiac action and hemodynamic levels. We used pregelled AgCl electrodes (Kendall Abro, H98SG) placed in a standard Lead II configuration for ECG and a four-spot electrode array for ICG (Sherwood et al., 1990). After the VU-AMS Data, Analysis & Management Software (VU-DAMS 3.0) detected R-peaks in the ECG, we visually checked and adjusted all R-peak markers when necessary. We calculated pre-ejection period (PEP, time in milliseconds in the cardiac cycle from initiation of ventricular depolarization to opening of the aortic valve and ejection of blood) and cardiac output (CO, the amount of blood in liters pumped by the heart per minute).

Responses along the cardiovascular challenge/threat dimension were operationalized as responses in PEP and CO. Shorter PEP reflects sympathetic activation (Seery, 2011). Shorter PEP is characteristic of physiological readiness for a motivated performance and is considered a prerequisite for interpreting CO as a physiological indicator of psychological challenge and threat (Blascovich, 2008). This initial cardiovascular response leads to the challenge- or threat-specific reactions and depends on an individual's evaluations of resources versus demands. Challenge evaluations lead to greater cardiac efficiency (i.e., increased CO), compared to threat evaluation that inhibits beneficial physiological mobilization (Seery, 2011). Traditionally, to operationalize challenge/threat responses, researchers also used total peripheral resistance (TPR, an index of net constriction vs. dilation in the arterial system; Blascovich, 2008). However, due to the technical limitations – participants in our study used both hands during the game – we were not able to measure blood pressure and, in turn, calculate TPR.

Emotions. For the manipulation check, participants reported retrospectively using a single-item rating scales on how much of four targeted emotions (amusement, anger, enthusiasm, and sadness) they experienced while watching the movies. The scales range from 1 = (*not at all*) to 7 (*extremely*).

Gaming experience. *FIFA* gaming experience was operationalized as the number of hours spent playing the game during a regular week within the past month. Gamers reported that they played from 1 hr to 34 hr per week ($M = 7.24$, $SD = 5.78$).

Analytical Strategy

Physiological data reduction. Physiological measures were scored using 120-s ensemble averages (prefilm baseline and the five matches). To operationalize physiological changes, we used reactivity scores corrected for the resting state levels; thus, we subtracted the levels of the prefilm baseline from the matches. Using difference scores is a standard strategy for the study of autonomic responses to psychological factors (Gross & Levenson, 1995; Kreibig, Samson, & Gross, 2013).

Manipulation check. First, to test whether film clips elicit targeted emotions, we used repeated-measures analysis of variance (rmANOVA) with Greenhouse-Geisser correction and calculated effect sizes (η^2). To examine differences between the conditions (e.g., whether self-reported amusement in response to the amusing film clips was higher than it was in response to the other film clips), we calculated pairwise comparisons reported as effect sizes (Cohen's *d*) with confidence intervals (95% *CI*). The difference is significant when 95% *CI* for the effect sizes did not include zero. We also used rmANOVA to demonstrate sympathetic activation while gaming. We compared PEP level during the match to PEP baseline levels before the film and match.

Primary analysis. To examine the effects of emotions on esports performance, we used path analysis with maximum likelihood estimation with robust standard errors (MLR), using mPlus 7.2 (Muthén & Muthén, 2012). We regressed the primary indicator of performance level (the difference between scored and lost goals) and secondary indicators of performance level (the number of shots on target, takeovers, fouls, accuracy of shots and passes, ball possession) on the mediators (approach tendency, challenge/threat evaluations, cardiac efficiency) and experimental conditions (elicited emotions). We controlled for the gaming experience by introducing it as a covariate for performance level and the mediators. We dummy-coded the experimental conditions such that significant differences in the model accounted for differences relative to the neutral condition. To account for the nonindependence of observations, we nested five rounds of responses within individuals (Muthén & Muthen, 2017; McNeish, Stapleton, & Silverman, 2017). We calculated RMSEA, the recommended fit index for the MLR. RMSEA estimator with values <.08, along with the CFI with values above .90 indicate acceptable fit (Bentler, 1990). After eliminating participants with missing data, we analyzed 928 rounds of responses (films and matches) nested within 208 gamers as each participant played five matches.

Results

Manipulation Check

As summarized in Table S1 and Table S2, watching film clips elicited the targeted emotions. Pairwise comparisons indicated that self-reported amusement was the highest in the amusing film condition, self-reported anger was the highest in the angry film condition, self-reported enthusiasm was the highest in the enthusiastic film condition, and self-reported sadness was the highest in the sad film condition (Table S3). Moreover, self-reported targeted emotions were highest in the corresponding film condition, (e.g., self-reported amusement was higher than self-reported enthusiasm in amusement film condition; Table S4). Only in the angry condition, we observed that self-reported levels of anger and sadness did not differ $d = 0.04$, 95% CI [−0.14, 0.22]. All effect sizes with confidence intervals for pairwise comparisons for differences in self-reported emotions between and within conditions are presented in Table S3–S4 in the online supplementary materials. Moreover, we found that gaming was characterized by increased sympathetic activation as indexed by shorter PEP ($M = 113.14$, $SD = 16.19$) when compared to prefilm baseline ($M = 115.22$, $SD = 15.44$), $d = 0.10$, 95% CI [0.01, 0.19], $F(1, 997) = 93.32$, $p < .001$.

Primary analyses. The final path model for the role of emotions in esports performance is presented in Figure 2. Descriptive statistics and correlations are presented in Table S5 and Table S6. This model fit the data well, $\chi^2(52) = 54.103$, $p = .39$, RMSEA = .01, 90% CI [.00, .02], CFI = .99. Nonsignificant paths had no effect on the model fit, $\Delta\chi^2(49) = 51.85$, $p = .36$, and were removed.

Did high-approach emotions lead to better performance compared to low-approach emotions and neutral conditions? Emotions did not influence performance directly compared to neutral conditions. We found no differences between conditions across performance indicators.

Did high-approach emotions produce stronger challenge responses to the performance compared to low-approach emotions and neutral conditions? We found that enthusiasm, $\beta = .22$, 95% CI [.16, .28] and amusement, $\beta = .12$, 95% CI [.06, .18] (rather than enthusiasm and anger) influenced performance-related approach tendency compared to the neutral conditions (see Figure 2). Effects of enthusiasm on approach tendency were higher than that of amusement $\Delta\beta = .10$, 95% CI [.03, .16], anger, $\Delta\beta = .23$, 95% CI [.14, .32], and sadness $\Delta\beta = .23$, 95% CI [.15, .30]. Moreover, effects of amusement on approach tendency were higher than anger $\Delta\beta = .13$, 95% CI [.05, .21], and sadness $\Delta\beta = .13$, 95% CI [.05, .20]. Unpleasant emotions did not influence approach tendency when compared to the neutral conditions. Moreover, emotions did not influence challenge/threat evaluations and cardiac efficiency compared to neutral conditions.

Did stronger challenge responses lead to better performance? We found that motivational, cardiac, and cognitive indicators of the challenge response were related to better performance. First, higher approach tendency was related to positive goal difference, $\beta = .06$, 95% CI [.01, .11] (see Figure 2) and number of shots on target, $\beta = .05$, 95% CI [.01, .10]. Second, gamers with higher cardiac output reactivity performed better as indicated by more positive goal difference, $\beta = .052$, 95% CI [.001, .103], higher accuracy of shots, $\beta = .06$, 95% CI [.01, .11], and lower number of fouls, $\beta = -.08$, 95% CI [−.14, −.02]. Third, gamers who displayed more positive challenge/threat evaluations achieved higher goal difference, $\beta = .21$, 95% CI [.13, .29], higher number of shots on target, $\beta = .20$, 95% CI [.13, .26], lower number of fouls, $\beta = -.10$, 95% CI [−17, −04], higher ball possession time, $\beta = .11$, 95% CI [.02, .20], and higher accuracy of passes, $\beta = .21$, 95% CI [.11, .30] (see Figure 2).

Was the emotions' impact on performance mediated by challenge responses? We found an indirect effect of enthusiasm and amusement on the game scores, namely mediation via a higher approach tendency (a full mediation). We found that gamers achieved better game results when their game was preceded by

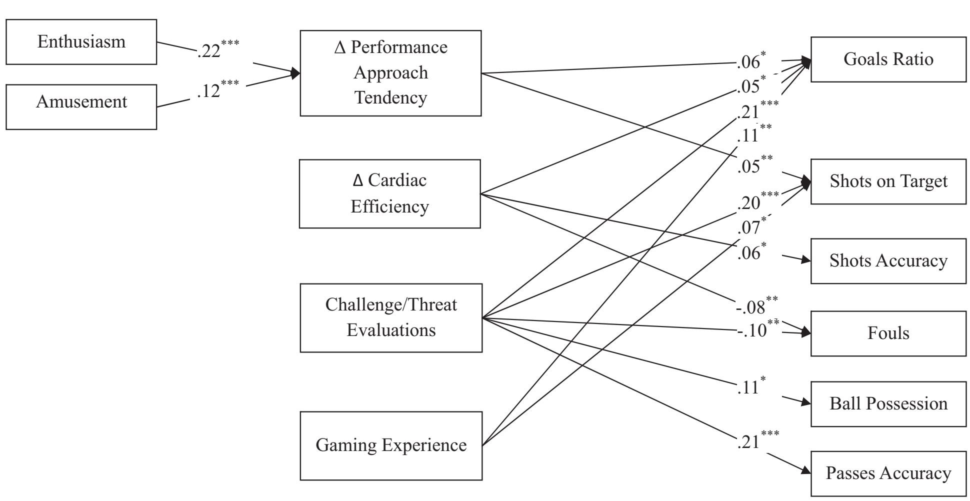

Figure 2. Final model for role of emotions in esports performance. Δ = change scores relative to prefilm baseline, Gaming Experience = number of hours played by week. * $p < .05$. ** $p < .01$. *** $p < .001$.

enthusiasm elicitation, indirect effect of $\beta = .023$, 95% CI [.003, .042], and amusement elicitation, indirect effect of $\beta = .013$, 95% CI [.001, .025], compared to the neutral condition because enthusiasm and amusement produced higher approach tendency (see Figure 2). Moreover, the indirect effect of enthusiasm was stronger than the indirect effect of amusement, $\Delta\beta = .010$, 95% CI [.001, .020]. Given no significant direct effect of emotions on performance, the effect of emotions on performance was fully mediated by approach tendency. We found no indirect effects of emotions on the performance that were operating via challenge/threat evaluations and cardiac output.

Did gaming experience influence the challenge response and performance? We found that gaming experience did not influence the challenge response to the performance. However, gaming experience predicted better performance, as indicated by a more positive goal difference, $\beta = .11$, 95% CI [.03, .19], and gaming style, as indicated by a higher number of shots on target, $\beta = .07$, 95% CI [.01, .14] (see Figure 2).

Discussion

We examined how emotions that differ in approach-avoidance tendencies and valence influenced performance outcomes in the esports context. We also examined whether cognitive (challenge/threat evaluation) and physiological (increased cardiac efficiency) processes would mediate any observed effects of emotions on performance. Contrary to expectations, we found no direct effects of emotions on the performance or challenge/threat response. However, our findings indicate that the influence of pleasant emotions on gaming-related outcomes was mediated by increased approach tendency. Moreover, across all conditions, gamers with higher challenge evaluations and increased cardiac efficiency performed better.

Implications for Motivation and Emotion

Our findings provide new evidence for the validity of the motivational dimensional model of affect. We found that elicited emotions characterized by pleasant valence differed in the intensity of approach tendency (Gable & Harmon-Jones, 2010; Harmon-Jones et al., 2013; Kaczmarek, Behnke, Enko, et al., 2019). We found that both pleasant emotions (amusement and enthusiasm) resulted in increased approach tendencies during the gameplay, compared to the neutral condition. However, enthusiasm produced stronger performance-related approach tendencies than amusement. This difference in approach tendency between enthusiasm and amusement translated into stronger positive behavioral effects for enthusiasm compared to amusement. This provides another functional argument that approach motivation is a meaningful element of the affective response (Harmon-Jones et al., 2013).

We limit our conclusion to emotions characterized by pleasant valence with no support for emotions characterized by unpleasant valence in this study. Gamers in the anger-provoking condition did not display the expected approach tendency (Gable & Harmon-Jones, 2010). This finding is likely to stem from the difference in methods of anger-elicitation that influence different forms of anger. We used a video clip (a racist attack) that elicited anger toward the attacker along with sadness resulting from empathic concern for the victim (Schaefer et al., 2010), whereas previous research on the motivational dimensional model of affect used self-reported trait anger (Harmon-Jones, 2003) or provoked anger by insulting participants (Harmon-Jones & Peterson, 2009). Therefore, our findings generalize to situations where anger commingles with sadness and might be different for anger less infused with other unpleasant emotions. Our study is in line with some previous studies which indicated that anger occurs in low-approach situations (Kaczmarek, Behnke, Enko, et al., 2019; Zinner et al., 2008) and should not always be treated as high-approach emotion (Carver & Harmon-Jones, 2009).

Implications for Motivation, Emotion, and Sports Performance

Our results integrate previous studies which indicated that pleasant emotions produce behavioral approach tendencies (Carver & White, 1994; Fredrickson, 2001) as well as studies showing that approach motivation promotes better performance (Friedman & Förster, 2005; Gable & Harmon-Jones, 2008; Roskes et al., 2011, 2013; Stoeber, Uphill, & Hotham, 2009). Although emotions did not influence successful gameplay directly, we found that the effects of emotions on outcomes were fully mediated by approach-avoidance motivational tendencies. We demonstrated that individuals are more likely to benefit from pleasant emotions relative to neutral affect preceding the performance (Rathschlag & Memmert, 2013, 2015; Totterdell, 2000). Moreover, our findings indicated that elicited unpleasant emotions have no detrimental impact on performance (Nicholls, Polman, & Levy, 2012; Turner, Jones, Sheffield, & Cross, 2012; Turner et al., 2013). We found that emotions influenced actions as long as they served to increase the approach motivational tendency, which is essential in mobilizing resources for successful performance (Mendes & Park, 2014).

The occurrence of mediation of effects that were deemed to be insignificant in the first place might be puzzling. Such a pattern is likely to emerge in mediation testing due to different levels of statistical power when testing direct and indirect effects (Kenny & Judd, 2014; O'Rourke & MacKinnon, 2015). Indirect effects, which are products of two or more coefficients, usually have more statistical power than single coefficients that represent direct effects. This might be the case for the present study, where the effects of emotions that we found were relatively small with standardized betas ranging from .12 to .22. Our findings indicate the advantage of the mediational analytical plan but also indicate that even greater statistical power would be required to ascertain that the effects of emotions on gaming behavior are likely to replicate in studies that use different or no mediators.

This study has practical implications. We presented the effects of watching enthusiasm-inducing and, to a lesser extent, amusing material to increase the performance-related approach motivational tendency, and, in turn, improve gaming performance. During gaming events, it might be useful for gamers to watch highlight videos, such as video montages of famous players performing well in past events. Moreover, gamers might create personal clips presenting their best plays to provide optimal preparation for performance. Finding new ways to facilitate performance is essential in sports and esports where players often present similar levels of professional competence, and winning or losing depends on peripheral factors such as emotions (Gould, Dieffenbach, & Moffett, 2002; Gould, Greenleaf, Guinan, & Chung, 2002; Pedraza-Ramirez et al., 2020). This study also is important because gaming and esports have been increasingly useful and popular during the COVID-19 pandemic. Video games offer a means to maintain high-quality entertainment during increased social isolation.

Linking Emotion and Challenge-Threat

Across all conditions, we found that the challenge-response for the upcoming performance predicted beneficial behavioral outcomes. This finding supports previous theories and studies that indicated how challenge evaluation and increased cardiac efficiency improves coping in stressful situations (Behnke et al., 2020; Blascovich, 2008; Hase, Hood, et al., 2019; Moore, Vine, Wilson, & Freeman, 2014). The present findings contribute to this literature by extending the generalizability of challenge/threat evaluations to esports. The replication aspect of this study is essential because several studies indicated that the effects presented in psychological literature are often not reproducible (Open Science Collaboration, 2015). This study also contributes to the diversity of empirical evidence for the biopsychosocial model of challenge and threat (Behnke & Kaczmarek, 2018). We added to the existing literature that accounted for types of performance that were central to participants' area of interest including surgery (Moore et al., 2014), aviation (Vine et al., 2015), university exams (Jamieson, Mendes, Blackstock, & Schmader, 2010), softball (Blascovich, Seery, Mugridge, Norris, & Weisbuch, 2004), cricket (Turner et al., 2013), and soccer (Dixon, Jones, & Turner, 2020).

Despite recognizing the role of challenge responses in the esport context, we observed that the challenge response was not influenced by the elicitation of emotions. These findings run contrary to some previous theoretical considerations (Jamieson et al., 2018; Jones et al., 2009) and evidence from empirical studies that indicated a link between challenge and pleasant emotions and threat and unpleasant emotions (Nicholls et al., 2012, 2014; Trotman et al., 2018; Williams, Cumming, & Balanos, 2010), and general conceptual similarities between challenge response and high-approach emotions (Blascovich, 2008). However, our findings are consistent with other works that emphasize the ambiguity of the association between emotions, the challenge/threat states, and performance (Meijen, Jones, McCarthy, Sheffield, & Allen, 2013, 2014; Turner et al., 2012, 2013; see Meijen et al., 2020, for the review). This ambiguity may result from the fact that the same emotion can be functional or dysfunctional, depending on individuals' evaluation and beliefs (Tamir & Bigman, 2018).

Our investigation is important because it adds to testing the variety of methods used to upregulate the challenge-response. Previous studies indicated that challenge evaluation could be upregulated by encouraging task instructions (Moore et al., 2012), performance-related feedback (Behnke et al., 2020), self-talk (Hase, Hood, et al., 2019), reappraising arousal (Sammy et al., 2017), or imagery (Williams et al., 2010). We found that our method of preperformance emotion elicitation influences behavior via a different pathway, namely, increased approach tendency rather than increased challenge evaluations. Future studies might examine further experimental methods (e.g., behavioral) that could result in an upregulated challenge response.

Limitations and Future Directions

The study has several limitations that bear noting. First, we observed that the previously validated short videos that we used elicited multiple emotions rather than the targeted emotion exclusively. It limits the interpretation of effects produced by a single emotion. In the case of amusing, enthusiastic, and sad video clips, we found expected self-reported emotions. We found the video clip that produced anger to be more problematic. Anger is triggered by external factors that pose a threat (physical or psychological) to an object or an individual that is personally meaningful (Ekman & Cordaro, 2011). Anger triggers the action of removing the obstacle or stopping the harm involving the wish to hurt the target (Ekman & Cordaro, 2011). In the video that we used in our study, the oppressor killed his victim. Thus, the clip elicited anger and sadness. The levels of sadness that our participants reported were higher than those of sadness reported in the validation study (Schaefer et al., 2010). Future research might pursue increasingly accurate methods to induce anger that is not accompanied by other negative emotions (Kaczmarek, Behnke, Enko, et al., 2019; Zinner et al., 2008). Furthermore, the enthusiastic clip presenting athletes was the video that most closely reflected the participants' experience. The similarity between the stimulus and participants' current situation might be the reason why this clip was the most engaging and motivating for participants. Future studies might use a variety of enthusiastic clips unrelated to sports activities.

Second, we focused on a single esports context. Although esports mimic the psychological demands of traditional sports performance, esports is an activity that takes place in a seated position and is relatively less energy-intensive than its traditional equivalent. This may limit the generalization of our results to precision sports like snooker or motorized sports. Moreover, soccer videogame requires creative plays and fast decision-making, similar to traditional team sports, including soccer or basketball. Emotions could have different implications in self-paced sports that require optimal execution of a well-trained task with the maximum effort, namely gymnastics, swimming, running, or weightlifting. Future studies might refine our understanding of the links between specific emotions and performance-related outcomes.

Third, we focused on four discrete emotions, namely amusement, anger, enthusiasm, and sadness. Thus, these emotions fill in four cells in valence (pleasant/unpleasant) and approach (low/high) 2×2 matrix. However, an exhaustive list characterizing emotional experience might also account for other dimensions (e.g., arousal, attention, certainty, dominance)(Cowen & Keltner, 2017). Future studies may examine the influence of other emotions common for sports performance (e.g., pride, schadenfreude, contentment, or preperformance anxiety), along with studying differences across other dimensions such as arousal or dominance. This is important to address alternative interpretations, such as arousal effects on performance (Arent & Landers, 2003).

Fourth, we limited our focus to a small number of specific measures related to physiological challenge/threat response and approach tendencies. For instance, we did not include TPR—the second index of challenge/threat physiological response. Participants in our study used both hands during the game. Thus, we were not able to measure blood pressure and, in turn, TPR. However, a recent meta-analysis showed that CO and TPR are both equally predictive for pleasant performance outcomes (Behnke & Kaczmarek, 2018). Moreover, CO and TPR showed more predictive effects when used independently in comparison to the use of the combination of CO and TPR as the challenge/threat index (Behnke & Kaczmarek, 2018). In future studies, it may be helpful to obtain a broader range of approach-related measures.

Fifth, we measured challenge/threat cardiac responses during the performance (Behnke et al., 2020; Frings, Eskisan, Spada, & Albery, 2015; Mendes, Blascovich, Lickel, & Hunter, 2002) rather than before the performance (Moore et al., 2012; Turner et al., 2012). Both approaches have their specific advantages and limitations that should be considered in assessing the fit of the approach with the current research aims. Some authors advocate for the measurement of cardiac patterns during the performance because this is the actual period where increased cardiac efficiency is expected to influence performance outcomes as it was the case in our study (Arthur, Wilson, Moore, Wylie, & Vine, 2019). Above all, the focus of this experiment was on the effects of elicited emotions on performance. Thus, we aimed to initiate the performance immediately after the emotions elicitation rather than separating the emotion elicitation from the performance with a break dedicated to the measurement of cardiovascular levels. Regardless of the benefits of the measurement of cardiac patterns during the performance, it is possible that the results might have been different if we had measured the link between preperformance challenge/threat indexes and the gaming outcomes. This is because levels during gameplay might have been influenced by the ongoing performance along with its subeffects (scoring a goal early in the game) that contribute to the final performance outcome (the final difference between scored and lost goals). Moreover, as noted above, esports have the advantage that the physical activity is minimal, relative to athletics or team sports that require gross body movements. Yet, the cardiac effects might have been influenced by physical activity. For instance, individuals who were losing and experiencing negative emotions might have produce more tonic muscular tensions (Huis in't Veld, Van Boxtel, & de Gelder, 2014). Future studies might compare whether preperformance cardiac levels are equally predictive of performance outcomes as performance cardiac levels. These studies might focus on how gaming subeffects influence challenge/threat dynamic and whether gaming cardiac patterns are significantly influenced or mediated by modulation of muscular tension.

Sixth, with the path analysis, we expected linear relations between challenge/threat physiological response and performance. Recent studies suggested the occurrence of the third type of response, namely blunted response (no reactivity; Dixon et al., 2020; Wormwood et al., 2019) that might lead to even more detrimental effects for performance, compared to threat response (Hase, Aan Het Rot, de Miranda Azevedo, & Freeman, 2020). Future studies on emotions and gaming performance might pursue this line of studies.

Finally, our participants were all young male gamers. It reflects the situation among sport-type gamers, where the vast majority, up to 98%, are male (Yee, 2016). Therefore, our results apply to male gamers, whereas future studies might focus on whether the results generalize to older and female gamers.

In summary, this study helps to clarify the link between emotions and sports performance. Notable strengths of this study include the use of an experimental approach with a large sample of highly motivated individuals in an esports performance context. This study also used a multimethod approach in order to assess affective, cognitive, and physiological responses in this gaming context. Using this multimethod approach, we found that emotions influence actions as long as they serve to increase the approach tendency. These results inform our understanding of how approach tendency and valence contribute to performance.

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