Journal of Sport and Exercise Psychology, (Ahead of Print)
https://doi.org/10.1123/jsep.2023-0104

First Published Online: Jan. 19, 2024

Human Kinetics
ORIGINAL RESEARCH

An Ego-Involving Motivational Climate Can Trigger Inflammation, a Threat Appraisal, and Basic Psychological Need Frustration in an Achievement Context

Candace M. Hogue
University of Minnesota, Twin Cities, Minneapolis, MN, USA

In this experimental investigation, male college students ($N = 56$; $M_{age} = 19.95$ years) who did not yet know how to juggle were randomly assigned to a 30-min instructional juggling session with either a caring, task-involving climate or an ego-involving climate. An inflammatory response to psychosocial stress was assessed via salivary interleukin-6 prior to ($t = 0$) and following ($t = +30, +45, +60$ min) the session. Surveys were utilized to examine positive and negative affect prior to the session and affect, psychological needs, challenge and threat appraisals, and perceived ability to juggle following the session. This is the first investigation to show that ego-involving climates can trigger inflammation, along with maladaptive psychological responses. Participants in the caring, task-involving climate responded with greater psychological need satisfaction, resource evaluations, positive affect, and perceived juggling ability. This research suggests there may be important physiological consequences to ego-involving climates, in addition to concerning cognitive, affective, and behavioral responses.

Keywords*:* achievement goal theory, cognitive appraisals, IL-6, leadership development, performance stress, psychosocial stress

There is overwhelming support for the creation of positive, mastery-focused environments in achievement-based settings when the goals are to help maximize performance potential and the experience of all participants (for reviews, see Fry & Hogue, 2018; Fry & Moore, 2019; Harwood et al., 2015; Roberts et al., 2018). Fry and Moore (2019) have illustrated how the motivational climate fostered by leaders can play a key role in determining how participants will respond and what benefits they will gain as a result of their participation in physical activities. They identified three theories that have guided the exploration of how to create satisfying and empowering environments including achievement goal theory (Ames, 1992; Dweck, 1986; Nicholls, 1984, 1989), caring theory (Newton et al., 2007; Noddings, 2003c, 2015), and self-determination theory (Deci & Ryan, 1985; Ryan & Deci, 2000, 2017). Each respective theory has provided insight into which controllable factors help leaders set participants up to optimize their potential, learning, and enjoyment. Likewise, social self-preservation theory (Dickerson, Gruenewald, et al., 2004; Gruenewald et al., 2007; Kemeny et al., 2004) has helped identify which psychosocial features of group-based achievement settings elicit concerning psychophysiological stress responses known to adversely impact participant performance, health, and well-being (Cohen et al., 2012; Miller et al., 2002; O'Connor et al., 2021), while the stress buffering hypothesis (Cohen & McKay, 1984; Cohen & Pressman, 2004; Cohen & Wills, 1985) has helped identify psychosocial factors that elicit more adaptive responses to stress. Stress has been defined in the current investigation as the anticipation or experience of encountering demands in one's goal-related contexts, in line with Crum et al.'s (2020) conceptualization. Collectively, this literature can help practitioners better understand the impact of the leader-driven motivational climate in performance contexts and provide guidance regarding how they might create more rewarding environments for participants and avoid harmful practices.

Nicholls defined the motivational climate as either task- or ego-involving, which is determined by the manner in which leaders structure activities (e.g., cooperative vs. hypercompetitive) and the type of encouragement and feedback given (e.g., treat mistakes as part of learning vs. punish mistakes). Achievement goal theory researchers later extended Nicholls's (1984, 1989) work by adding a relationship-based component, built on caring theory (Noddings, 2003b, 2003c, 2015), referred to as a caring climate. Caring climates have been shown to help engender advantageous responses in physical activity-based achievement settings (Back et al., 2022; Fry et al., 2012; Fry & Gano-Overway, 2010; Gano-Overway & Peterson, 2023)—benefits which are believed to be maximized when created in concert with a highly task-involving climate (Fry et al., 2021, 2023; Gano-Overway & Carson Sackett, 2021; Hogue et al., 2019; Iwasaki & Fry, 2016). Although conceptually distinguishable, there is a growing consensus that both caring and task-involving features should be emphasized in achievement-based settings, including physical activity and/or motor learning-based settings (e.g., physical education class; Chamberlin et al., 2017; Fry & Moore, 2019; Gould et al., 2012; Harvey et al., 2023; Martin et al., 2016; Spruit et al., 2019). In task-involving climates (TICs), leaders treat mistakes as part of the learning process, encourage cooperative learning where everyone has an important role to play, and emphasize the importance of working hard and improving. Caring climates include environments where participants experience a sense of belonging and are made to feel safe, welcome, and respected. There is considerable empirical support for the creation of caring TICs in performance contexts (CTICs), as they are consistently linked to adaptive outcomes in achievement-based settings including a range of psychological and behavioral responses such as increased self-confidence, high levels of effort and enjoyment, positive relationships with coaches and teammates, engagement in caring behaviors, and empathetic self-efficacy (for reviews, see Fry et al., 2020; Fry & Hogue, 2018; Fry & Moore, 2019).

Address author correspondence to chogue@umn.edu, https://orcid.org/0000-0002-0171-3817

Performance settings with ego-involving climate (EICs) have been shown to yield markedly different responses. EICs are defined as achievement contexts where leaders (e.g., instructor, coach) punish participants for making mistakes, pit participants against one another, place great emphasis on outperforming others and winning, favor the most talented or those with the "most potential," and give the majority of praise and positive recognition to the best performers (e.g., the star athletes). Cross-sectional and longitudinal research has shown that EICs typically yield less adaptive responses including poor motivational responses (e.g., a diminished interest in engagement), increased negative affect, heightened cognitive and somatic anxiety, and a fear of making mistakes (for reviews, see Fry & Hogue, 2018; Fry & Moore, 2019; Harwood et al., 2015; Roberts et al., 2018). What is less understood are physiological stress responses to the perceived motivational climate in performance contexts.

Hogue and colleagues (Hogue et al., 2013, 2017, 2021) have completed a series of experimental investigations examining the impact of the motivational climate on participants' psychological and physiological responses to performance stress while learning a new motor skill (i.e., juggling) in a group setting with either a CTIC or EIC. These investigations have revealed that the participants in the CTIC groups, which involved college students (Hogue et al., 2013, 2021) and middle school students (Hogue et al., 2017), responded with favorable cognitive, affective, and physiological responses including insignificant (no) cortisol responsivity (Hogue et al., 2017) or a decrease in cortisol (i.e., a stress-responsive hormone) following the juggling sessions (Hogue et al., 2013, 2021)—which are considered adaptive physiological responses to performance stress. Participants in the CTICs also reported more enriching emotional and motivational experiences including greater self-confidence (Hogue et al., 2013, 2017); effort (Hogue et al., 2013, 2017), enjoyment (Hogue et al., 2013, 2017), intent, excitement, and/or interest in continuing to practice the skills they learned (Hogue et al., 2013, 2017, 2021), social and performance self-esteem (Hogue et al., 2021), pride in their accomplishments (Hogue et al., 2021), and positive affect (Hogue et al., 2017, 2021) compared with those who were taught to juggle in an EIC, to name a few of the more advantageous responses recorded. Finally, the CTIC participants reported negligible feelings of self-conscious states and notably low levels of threatening psychosocial stressors such as feelings of uncontrollability and negative social evaluation (Hogue et al., 2013, 2017, 2021).

In contrast, participants who were taught to juggle in an EIC had more adverse responses to learning to juggle in a group setting among their peers. Responses to an EIC in this series of experimental investigations included reliable elevations in cortisol (Hogue et al., 2013, 2017, 2021), the presence of threatening psychosocial stressors including critical social evaluation (Hogue et al., 2017, 2021) and feeling that they do not have control over their own success (Hogue et al., 2021). Participants also reported psychosocial stress responses including shame (Hogue et al., 2017), humiliation (Hogue et al., 2017, 2021), embarrassment (Hogue et al., 2021), and feeling self-conscious (Hogue et al., 2013, 2021). Finally, middle school students in an EIC group also reported much lower ratings of subjective social status (4.5/10) than those in a CTIC group, who reported much higher ratings (8/10) of subjective social status (Hogue et al., 2017). Also important to note, in similar investigations that did not include CTICs, Breske et al. (2017), Hogue (2019), and Hogue (2020) also found a rise in salivary cortisol in participants (college students and youth athletes) who were taught to juggle in an EIC. What has not yet been experimentally investigated is whether an EIC triggers an inflammatory response, as measured by salivary interleukin-6 (IL-6).

Inflammation has been described as "the immune response to infection, tissue damage, or stress, coordinated by pro-inflammatory cytokines including IL-6, IL-1β, and tumor necrosis factor alpha" (Bower & Kuhlman, 2023, p. 332). Cytokines are messenger proteins that facilitate communication between cells which activate and help regulate the inflammatory response. Pro-inflammatory cytokines typically enhance inflammation, whereas anti-inflammatory cytokines tend to downregulate, or decrease, inflammation. Some cytokines, however, appear to have both pro- and anti-inflammatory functions (e.g., tumor necrosis factor alpha). IL-6 and IL-1β are pro-inflammatory cytokines that have been used as markers of psychosocial stress in previous research, as has salivary cortisol (i.e., a catabolic hormone; Man et al., 2023; Marsland et al., 2017; Sjögren et al., 2006). It is important to note that high-intensity exercise can elicit a rise in inflammation and cortisol, serving adaptive functions in response to physical stressors, which do not necessarily hinder performance (Tibana et al., 2016). However, understanding whether the motivational climate elicits an inflammatory response to psychosocial stress is important as inflammation linked to psychological stress has been shown to play a role in poor mental and physical health outcomes (e.g., depression), as well as isolating and submissive behavioral responses and social disconnection (Eisenberger & Moieni, 2020; Elenkov et al., 2005; Lovallo, 2016)—none of which typically serve adaptive functions in performance contexts.

Researchers have also not yet experimentally investigated whether the motivational climate impacts psychological need satisfaction and frustration. The achievement goal theory and self-determination theory literature often overlap (e.g., Duda & Appleton, 2016), as these two leading theories of motivation have considerably advanced our understanding of what factors help participants develop as individuals, optimize their learning and motivation, and have a satisfying experience as a result of their participation in goal-oriented endeavors (Ntoumanis et al., 2021; Roberts & Nerstad, 2020; Ryan et al., 2022; Vasconcellos et al., 2020). According to basic psychological needs theory, a subtheory of self-determination theory (Deci & Ryan, 1985; Ryan & Deci, 2000, 2017), the satisfaction of three basic psychological needs (i.e., competence, relatedness, and autonomy) are central to cultivating self-determined behavior and promoting psychological health and well-being (Deci & Ryan, 2012; Ryan & Deci, 2000). In performance contexts, basic psychological needs can be explained as the feeling that one is proficient and able to improve their skills (competence), feeling that they are connecting with others in a meaningful and positive way (relatedness), and feeling that they have control over what happens to them, their development, and how decisions are made (autonomy). A body of literature supports Deci and Ryan's contentions and has illustrated how need fulfillment consistently fosters more adaptive motivational responses and promotes greater well-being, while need frustration leads to more adverse outcomes including feelings of exhaustion and negative affect (Bhavsar et al., 2020; Ryan & Deci, 2007, 2017).

Cross-sectional investigations have been able to link TICs to basic psychological need satisfaction in physical activity-based settings (e.g., Bhavsar et al., 2020; García-González et al., 2019), but there is a scarcity of research examining these relationships in

experimental, highly controlled contexts. Given the cooperative approach toward achievement striving in TICs and the focus on fostering a sense of belongingness and developing positive interpersonal relationships in caring climates, it seems reasonable that a CTIC would lead to greater relatedness satisfaction compared with an EIC. Likewise, by focusing on controllable achievement elements including effort and improvement in a CTIC, the need for competence and autonomy may also be satisfied. It would be challenging, however, to examine the need for autonomy in a highly controlled experimental investigation.

Psychoneuroendocrine research can also help inform research on leadership development within sport and exercise psychology. For instance, social self-preservation theory and the supporting literature have helped identify features of group-based performance settings that procure deleterious psychophysiological responses (Dickerson, Gruenewald, et al., 2004, 2009; Gruenewald et al., 2004, 2007; Kemeny et al., 2004). According to social self-preservation theory, settings where participants experience an actual or perceived loss of social esteem, social status, or acceptance by others trigger a coordinated and adverse response. Gruenewald et al. (2007) further explained such settings include "situations in which one's competencies, abilities, or characteristics upon which a positive social image is based are called into question, or situations of potential or explicit exclusion, scorn, or rejection" (p. 69). In support of these contentions, a meta-analysis of over 200 studies found group-based performance settings where participants experienced negative social-evaluation or felt that they did not have control over their own success (i.e., "uncontrollability") both reliably induced a rise in salivary cortisol (Dickerson & Kemeny, 2004). Cortisol typically helps regulate inflammation, but researchers have found that when critical social evaluation and feelings of uncontrollability are present in achievement contexts, this can elicit a dual rise in cortisol and inflammation, including the pro-inflammatory cytokine IL-6 (Izawa, Sugaya, et al., 2013; Slavish & Szabo, 2019). IL-6, has been linked to depression, exhaustion, and feelings of hopelessness (Sjögren et al., 2006), and is believed to contribute to poor immunity and ill-being, as well as enhanced sensitivity to pain and low vitality (Cohen et al., 2012; Eisenberger & Moieni, 2020; Elenkov et al., 2005)—all of which are likely to have a negative impact on health and impair athletic performance. Likewise, social self-preservation theory researchers also have discovered that psychosocial threats, including negative social evaluation and uncontrollability in group-based achievement contexts, reliably elicit shame-related emotions and submissive behavioral responses, in addition to elevations in cortisol and inflammation (Dickerson, Gruenewald, et al., 2004, 2009; Gruenewald et al., 2004, 2007; Kemeny et al., 2004). Collectively, these responses render participants uniquely vulnerable to poor psychological functioning and ill-being (Dickerson et al., 2008; Dickerson, Gable, et al., 2009; Dickerson, Gruenewald, et al., 2004; Dickerson, Kemeny, et al., 2004; Gruenewald et al., 2007; Kemeny et al., 2004; Rohleder et al., 2008).

Social support, in contrast, has been shown to elicit more advantageous psychological and physiological responses to stress, including protective responses (Uchino, 2006). Crum et al. (2020) define stress as "the anticipation or experience of encountering demands (e.g., danger/conflict, uncertainty, or pressure) in one's goal-related contexts" (p. 122). Group-based achievement settings where participants are striving to develop new skills such as juggling could therefore be considered a stressful experience, as would taking part in a sport, physical education class, or group-based exercise classes for goal-oriented participants. Minimizing negative social evaluation and setting participants up to feel competent and that they have control over their own success, then, may protect against some of the more menacing characteristics of performance settings (e.g., critical judgment and uncontrollability). It should be noted, however, that psychosocial stress is still a characteristic of any group-based setting where achievement and/or development are the focus, even when leaders structure activities so that they are cooperative and supportive and where controllable factors such as effort and improvement are rewarded (e.g., in a CTIC). For instance, performance is judged publicly in games and competitive sport. Also, leaders do not always have control over how peers interact with one another, participants' cognitive responses, or parental and other significant influences. Social support in these contexts may help elicit protective responses. It is worth examining, then, whether actively working to enhance social support (e.g., by creating a caring climate) might help protect against, or buffer, the more harmful responses to psychosocial stress. The stress buffering hypothesis and related research has shown that feeling valued and cared for, experiencing a sense of belonging, receiving emotional support, and engaging in open communication can elicit health promoting, protective responses even while one is managing high levels of stress, including those that would typically elicit more concerning responses such as elevations in cortisol and inflammation (Cassel, 1976; Cobb, 1976; Cohen & McKay, 1984; Heinrichs et al., 2003; Uchino, 2006).

Another factor shown to help predict how participants respond to stress is the balance between demand and resource evaluations. Challenge appraisals (also referred to as challenge states) reflect motivated performance settings where evaluations of resources outweigh demands (Crum et al., 2017). The research suggests challenge appraisals can foster more adaptive responses in performance contexts including healthier cardiovascular reactivity and better cognitive functioning (Akinola et al., 2016; Hase et al., 2019). In contrast, when situational demands outweigh personal resources during motivated performance tasks, this reflects a threat appraisal (also referred to as a threat state), which has been linked to more maladaptive responses including elevated cortisol, negative affect, and poor cardiovascular reactivity (e.g., greater diastolic blood pressure; Maier et al., 2003). Although findings do not always align with the prediction that a challenge appraisal will be associated with an adaptive response, a recent systematic review did reveal that over 70% of relevant studies found challenge appraisals during motivated performance tasks were linked to better performance compared with the performance of those with threat appraisals (Hase et al., 2019). Given the supportive and mastery-focused approach toward achievement striving in settings with high CTICs and lower perceived threats and other stressors (Hogue et al., 2013, 2021), it seems reasonable to predict that participants in CTICs would report greater resource evaluations, compared with demand evaluations. It also seems reasonable to expect that participants in EICs would report greater demand evaluations compared with resource evaluations, given the focus on uncontrollable elements of performance (e.g., winning). These respective evaluations of demands and resources, in turn, may then correspond to a challenge appraisal for participants in a CTIC and a threat appraisal for those in an EIC.

The primary purpose of this experimental investigation was to examine participants' inflammatory responses, as measured by salivary IL-6, to the perceived motivational climate (i.e., caring, task- vs. ego-involving) while immersed in a group-based achievement setting where participants were taught a new motor skill (i.e., juggling). As a secondary purpose, psychological responses

including satisfaction and frustration of the basic psychological needs of competence and relatedness were examined, along with affect, psychosocial stress, demand and resource evaluations (to determine challenge/threat appraisals), and psychological appraisals of ability to juggle and the confidence to juggle. It was hypothesized that participants placed in the EIC would respond with more maladaptive physiological stress and psychological responses, post-climate exposure, including greater IL-6 levels, basic need frustration, threat appraisals (i.e., situational demands exceed personal coping resources), negative affect, and psychosocial stress compared to participants immersed in a CTIC. In contrast, it was hypothesized that participants placed in the CTIC would report greater need satisfaction, challenge appraisals (i.e., personal coping resources exceed situational demands), positive affect, and psychological appraisals of ability to juggle and confidence to juggle.

Methods

Participants

Participants were male college students ($n = 56$, age range: 18–27 years, $M_{age} = 19.95$, $SD = 1.90$) who did not yet know how to juggle. They were prescreened for potential confounds and agreed to adhere to the prestudy instructions (see "IL-6" section below). Potential confounds that were screened for included poor oral health, smoking, heavy alcohol consumption, medication use, age (must be < 30 years old), psychological disorders, autoimmune diseases, current illness, and recent vaccination (within past 2 weeks). For a review of methodological considerations, when measuring salivary markers of inflammation see Szabo and Slavish (2021). In order to maximize statistical power, given limited funding, females were excluded due to the impact menstrual cycle can have on inflammation. Power analyses based on research with male participants experiencing psychosocial stress suggest 27 participants in each group would be necessary to identify differences in IL-6, at 80% power. This is also a greater number of participants per group than similar investigations that have been able to identify a significant rise in salivary IL-6 post exposure to psychosocial stress (e.g., Izawa, Sugaya, et al., 2013).

Accepted participants were randomly assigned to a CTIC ($n = 29$) or an EIC ($n = 27$) and were paid $20 for taking part in the study. Each accepted participant was assigned a number from 1 to 60. A random number generator was used to determine climate assignment. Specifically, participants with the first 30 numbers that were randomly generated were assigned to the CTIC group, while the remaining participants were assigned to the EIC group. Six participants were removed from the IL-6 analyses (four from CTIC, two from EIC) because they did not follow the prestudy instructions. Participants reported as White (50%), Pacific Islander/Asian (21.4%), African American (8.9%), Other (7.1%), Multicultural (8.9%), and Hispanic/Latina (3.6%).

Procedure

The study was approved by the Institutional Review Board at Pennsylvania State University (STUDY00017545). Data collection took place on consecutive Tuesday afternoons between 4:30 and 7:30 p.m. to help control for diurnal variations in IL-6 (Izawa, Miki, et al., 2013). Upon arrival ($t = -20$ min), participants rinsed their mouth with water. The study was introduced, consent was received, and the participants completed the presession questionnaires (see Figure 1 for a timeline). Participants then provided their baseline saliva sample ($t = 0$ min) and were immediately led to a gym where the instructional juggling sessions with either a CTIC or an EIC took place, following the Hogue et al., (2013) protocol. On average each group had two instructors, two confederates (i.e., fake participants), and eight participants. To summarize, in the CTIC the confederates and instructors made an effort to highlight the importance of trying one's best and focused on improvement, working together, and treating everyone with kindness and respect. In contrast, in the EIC emphasis was placed on winning and outperforming others and participants were punished for making mistakes (e.g., taken out of a group activity and told to practice on their own). Also, participants were pit against one another and ranked according to their performance. When in the EIC, confederates pretended to learn a little faster than the other participants and received the majority of praise. They were also ranked the highest. Immediately after the climate manipulation ($t = +30$ min),

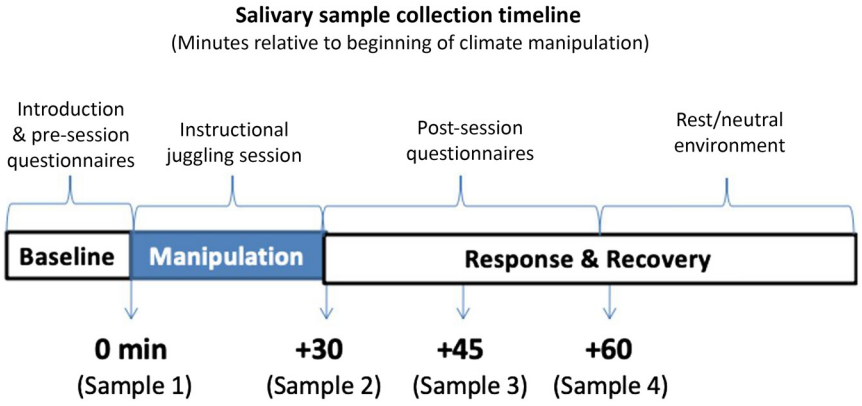

Figure 1 — Timeline of salivary sample collections for the quantification of interleukin-6 (below) and study activities (above). *Note.* Sample 1 is the baseline sample; Samples 2, 3, and 4 are response and return-to-baseline samples. The presession questionnaire included measures and questions assessing demographics, potential confounding behaviors by participants (e.g., time of last meal), and positive and negative affect. The postsession questionnaires included measures and questions assessing the perceived motivational climate, positive and negative affect, competence and relatedness satisfaction and frustration, and demand and resource evaluations; individual items assessing psychosocial stress and stress responses during the juggling session; and perceived ability and confidence to juggle.

participants provided their first of three saliva response samples. Samples were also provided at $t = +45$ and $+60$ min while participants completed their postsession questionnaires, since there is a delayed response in salivary IL-6 after acute psychological stress exposure (Steptoe et al., 2007). As a result, the saliva samples collected postmotivational climate exposure were assumed to reflect participants' physiological responses to any psychosocial triggers present within each respective motivational climate. After completing their surveys, participants waited in a neutral environment until the end of the study when they were debriefed. After debriefing, participants in the EIC were invited to come back to experience the CTIC, although no one chose to return.

Instructor Training

Undergraduate students familiar with the motivational climate literature were recruited to be instructors. Each took part in a total of 9 hr or more of training. Instructors were encouraged to use their theoretical understanding of achievement goal theory during the juggling session and to follow the protocol developed by Hogue et al. (2013) and validated by others (Breske et al., 2017; Hogue, 2019, 2020; Hogue et al., 2017, 2021) during the instructional juggling session.

Inflammatory Response

Prior to study arrival, participants were asked to adhere to prestudy instructions in order to avoid potential confounds (e.g., avoid consuming calories for 1 hr prior to arriving). During the investigation, participants provided a total of four saliva samples via passive drool, including one baseline ($t = 0$ min) and three responses measures (+30, +45, +60 min, relative to the start of the juggling session) in order to assess fluctuations in IL-6 (see Figure 1 for the sampling timeline). Passive drool is a reliable means of assessing this marker of inflammation. In order to provide a saliva sample via passive drool, participants were asked to guide their saliva down a small straw (i.e., a collection aid; Salimetrics) into a cryovial (Salimetrics®, University Park) for storage and analysis. A cryovial is a small plastic vial with a screw cap on top of the vial that comes off when participants are ready to provide their samples. Participants were told to fit the small straw into the top of the vial and to wait and pool their saliva. They were told to guide their saliva down the straw into the tube once they pooled their saliva. Participants were asked to repeat this until their saliva reached a specific line on the vial (i.e., 1.8 ml). This helped ensure enough saliva was collected to allow for analysis. Each vial was labeled by participant number and sample number. These labels were color coded (e.g., for Sample 1, the participant number and sample number were written in blue). Once samples were completed, they were collected and then immediately frozen at −20 °C until analyzed. Samples were analyzed in duplicate in house using Salimetrics EIA kits (Salimetrics). Mean intra- and interassay coefficients of variability (%) for salivary IL-6 were 6.68% and 8.84%, respectively, which are acceptable levels for assay variability within and between assays (Thomsson et al., 2014), respectively.

Psychological Questionnaire

Motivational Climate Perceptions. As a manipulation check, the Perceived Motivational Climate in Sport Questionnaire (PMCSQ; Seifriz et al., 1992) and Caring Climate Scale (CCS; Newton et al., 2007) were used to assess the perceived motivational climate during the instructional juggling session. A 5-point Likert-style scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*) was used. Scores were averaged for EIC, TIC, and caring climate perceptions, with lower scores (closer to 1) indicating weaker perceptions of the respective climate and greater scores (closer to 5) indicating stronger perceptions of the climate. The stem for each item read, "During the juggling session . . . ."

Caring Climate. The CCS (Newton et al., 2007) is a 13-item scale that measures the extent to which individuals feel cared for, valued, and respected. The CCS was used to quantify caring perceptions during the juggling session. A sample item was "Participants were treated with respect." The CCS has demonstrated strong psychometric properties in similar studies with college age students (Breske et al., 2017).

Task- and Ego-Involving Climates. The 21-item PMCSQ was used to measure the extent to which participants perceived the climate as task- and ego-involving. An example task-involving item is "Each participant's improvement was important," while an example ego-involving item is "Participants were encouraged to outplay each other." The PMCSQ has demonstrated strong psychometric properties in similar studies with college age students (Breske et al., 2017).

Psychological Outcomes

Need Satisfaction and Frustration. The Psychological Need States in Sport Scale (Bhavsar et al., 2020) was used to assess basic psychological need satisfaction and frustration during the instructional juggling session. Participants were asked to indicate the extent to which they agreed or disagreed with statements reflecting need satisfaction and frustration for the basic psychological needs of competence and relatedness only (19 items). Questions reflecting autonomy satisfaction and frustration were omitted (10 items) due to the highly regimented nature of the investigation. Responses were recorded using a 7-point Likert-style scale, 1 (*strongly disagree*) to 7 (*strongly agree*), and the average response for each respective scale was calculated for each group with scores closer to 1 reflecting less need satisfaction or frustration, respectively, and scores closer to 7 reflecting stronger need satisfaction or frustration, respectively. "During the juggling session . . . " was used as a stem for all items. Example items for competence satisfaction and frustration are "I felt confident that I could do well" and "I felt incapable," respectively. Example items for relatedness satisfaction and frustration include "I felt connected" and "I felt excluded," respectively. This scale has shown acceptable psychometric properties with adult populations (Bhavsar et al., 2020; Rodrigues et al., 2021).

Demand and Resource Evaluations. The balance between evaluations of situational demands and personal coping resources was used to measure challenge and threat appraisals for each group. Participants' evaluations of demands and resources during the instructional juggling session were assessed using Mendes et al. (2007) challenge and threat measure. Items were altered to reflect the instructional juggling session. A total of six demand and five resource questions were included using a Likert scale that ranged from 1 (*strongly disagree*) to 7 (*strongly agree*). Examples included "The juggling session was threatening" (demand) and "I felt I had the abilities to perform well during the juggling session" (resource). Each subscale was averaged. A threat or challenge appraisal was determined by using the average demand/average resource ratio. A demand/resource ratio of >1 reflects a threat appraisal, while ratios <1 reflect a challenge

appraisal (Mendes et al., 2001). This measure has been shown to have acceptable psychometric properties (Mendes et al., 2007).

Affect. The Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) was used to assess feelings and emotions reflective of positive and negative affect during the instructional juggling session. The PANAS includes 10 items assessing both positive and negative affect using a 5-point Likert scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*). A total score for each scale is calculated, with greater scores (closer to 50) reflecting more intense experiences of positive or negative affect, respectively, and lower scores (closer to 10) reflecting less intense experiences of positive or negative affect. The stem "During the juggling session, I was . . . " was used. An example positive affect item is "enthusiastic" while an example negative affect item is "irritable." The PANAS has consistently displayed strong psychometric properties with adults (Watson et al., 1988).

Individual Psychological Items

Psychosocial Stressors and Stress Responses. Four individual items were included to help determine the presence of psychosocial stressors during the instructional juggling session including "I found the juggling session stressful," "I felt like I was being negatively evaluated by the instructors during the juggling session," "I felt like I was being judged by other participants during the juggling session," and "I didn't feel like I had control over my own success during the juggling session." Four individual items were also used to quantify participants' experiences of psychosocial stress during the juggling session including "I experienced shame in the juggling session," "I felt humiliated when I was in the juggling session," "I felt embarrassed in the juggling session," and "I felt self-conscious during the juggling session." Responses were assessed using a 7-point Likert style scale ranging from 1 (*not at all*) to 7 (*very much so*). The average of each item was calculated for each climate group (i.e., CTIC vs. EIC), with greater scores (closer to 7) reflecting more robust stress experiences.

Psychological Appraisals of Ability to Juggle and Confidence to Juggle. Additional individual items postjuggling session included, "Indicate the greatest number of tennis balls you think you can juggle at once, consecutively, at this moment in time" (1, 2, or 3) and "How confident are you that you would be able to juggle 3 balls continuously in front of another person?" The latter item used a 5-point Likert scale ranging from 1 (*I am not at all confident*) to 5 (*I am extremely confident*). Scores for each item were averaged for the CTIC and EIC groups.

Analyses

A 2 (Climate: CTIC vs. EIC) × 4 (Time: t 0 vs. $t + 30$ vs. $t + 45$ vs. $t + 60$) repeated-measures analysis of variance was conducted to assess changes in inflammation (i.e., salivary IL-6), with climate assignment treated as the between-subjects variable and time of sample treated as the within-subjects variable. There were three outliers for each group for IL-6, which were replaced with the mean plus three *SD*s for each respective saliva sample by group. The salivary IL-6 responses were positively skewed. As a result, log transformation was used. Because the assumption of sphericity was violated for IL-6, as assessed by Mauchly's test of sphericity ($p < .001$), multivariate tests were used to assess group differences. Single time point within-group differences (e.g., to identify changes from baseline levels) were assessed using paired sample t tests. Between-group differences for each respective time point were assessed using independent samples t tests. Alpha levels were set at $p \leq .05$, which were adjusted using Bonferroni correction for follow-up analyses when significant group differences were found and multiple samples were collected.

Group differences in psychological variables measured both before and after the juggling session (i.e., positive and negative affect) were assessed using a 2 (Climate: CTIC vs. EIC) × 2 (Time: Pre- vs. Postjuggling session) multivariate analysis of variance (MANOVA). Climate assignment was treated as the between-subjects variable and time was treated as the within-subjects variable. MANOVA's were used to assess group differences for the remainder of the psychological variables and climate perceptions, with climate assignment treated as the between-subjects variable. MANOVA groupings are indicated in the "Results" section below. Regarding missing data, one participant failed to respond to the task-involving climate item "During the juggling session participants tried to learn new skills." The average of that participant's responses for the remainder of the task-involving climate scale was used to estimate his score for that missing item. Psychological responses met the assumptions for normality and there were no statistical outliers. High correlations were found for the "Psychosocial stress responses." When significance in a MANOVA was found, independent samples t tests were used as follow-up analyses to determine whether there were significant group differences for each respective variable.

Results

See Figure 2 for IL-6 responses and Table 1 for means and Cohen's d for psychological outcomes. Table 2 includes correlations between climate perceptions, IL-6 responses, psychosocial stressors, and psychosocial stress responses by climate assignment. Table 3 includes correlations between climate perceptions and psychological outcomes by climate assignment and Cronbach's alphas for each respective scale.

Motivational Climate Manipulation Check

In order to verify the intended motivational climate was perceived by participants in each group (i.e., CTIC vs. EIC), a manipulation check was run with caring, task-involving and EIC perceptions run in the same MANOVA. There was a significant main effect for climate, $F(3, 52) = 145.89$, $p < .001$, partial $\eta^2 = .89$. Follow-up analyses revealed a significant difference between groups in the perceptions of a caring climate, $t(1, 54) = 33.62$, $p < .001$, Cohen's $d = 0.55$, task-involving climate, $t(1, 54) = 8.76$, $p < .001$, Cohen's $d = 0.63$, and EIC, $t(1, 54) = 12.73$, $p < .001$, Cohen's $d = 0.60$. Participants in the CTIC group reported perceiving a significantly more caring ($M = 4.79$, $SD = 0.29$; $t(1, 28) = 20.53$, $p < .001$, Cohen's $d = 0.73$) and task-involving climate ($M = 4.19$, $SD = 0.53$; $t(1, 28) = 13.33$, $p < .001$, Cohen's $d = 0.89$), compared with EIC ($M = 1.99$, $SD = 0.62$). Likewise, participants in the EIC perceived a significantly more EIC ($M = 4.03$, $SD = 0.58$), compared to a caring ($M = 2.07$, $SD = 0.74$; $t(1, 26) = 10.44$, $p < .001$, Cohen's $d = 0.98$) and a task-involving climate ($M = 2.72$, $SD = 0.72$; $t(1, 26) = 8.77$, $p < .001$, Cohen's $d = 0.78$).

Inflammatory Response

Inflammation levels, as measured by salivary IL-6, are displayed in Figure 2 by climate assignment. The main effect for Time was significant at, $F(3, 46) = 6.94$, $p < .001$, partial $\eta^2 = .31$, as was

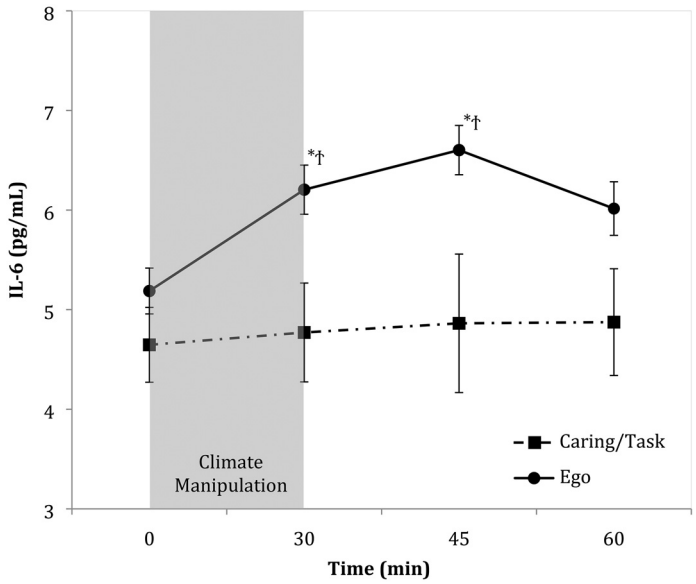

Figure 2 — Salivary IL-6 responses over time by group (i.e., caring, task-involving vs. ego-involving). Mean IL-6 in picograms per milliliter at baseline ($t = 0$ min) and following the 30-min climate manipulation ($t = 30$, 45, and 60 min). Vertical lines with cross bars represent ± *SE*, and * indicates significant group differences, while † represents within-group significant differences from baseline for the ego-involving climate group at $p < .05$. IL-6 = interleukin-6.

the Time × Group interaction, $F(3, 46) = 3.54$, $p = .006$, partial $\eta^2 = .24$, suggesting the IL-6 responses varied over time by climate. The test of between-subjects effects for Group was also significant, $F(1, 48) = 5.72$, $p = .021$, partial $\eta^2 = .11$. Comparison of group differences indicated there were no significant differences at baseline (i.e., $t = 0$ min) for IL-6 levels, $t(1, 48) = 1.27$, $p = .211$ nor were there significant differences at Time 4 ($t = +60$ min), $t(1, 48) = 1.74$, $p = .090$. However, the EIC group responded with significantly greater IL-6 at Times 2 and 3 ($t = +30$ and $+45$ min postclimate exposure, respectively), $t(1, 48) = 3.01$, $p = .004$, Cohen's $d = 0.11$ and, $t(1, 48) = 2.32$, $p = .024$, Cohen's $d = 0.15$, compared with the CTIC group. Follow-up analyses revealed no significant changes from baseline for the CTIC group for each response measure including Sample 2, $t(1, 26) = .65$, $p = .522$, Sample 3, $t(1, 26) = .83$, $p = .413$, and Sample 4, $t(1, 26) = .71$, $p = .486$. There was a significant rise in IL-6 postclimate exposure for the EIC group, from baseline, for Times 2 ($t = +30$ min), $t(1, 22) = 4.99$, $p < .001$, Cohen's $d = 0.07$ and 3 ($t = +45$ min), $t(1, 22) = 2.64$, $p = .015$, Cohen's $d = 0.15$, respectively, but not Time 4 ($t = +60$ min), $t(1, 22) = 1.69$, $p = .106$.

Psychological Outcomes

Need Satisfaction and Frustration

There was a significant main effect for climate for competence and relatedness need satisfaction and frustration, $F(4, 51) = 32.34$, $p < .001$, $\eta^2 = .72$. Follow-up analyses revealed group differences for competence satisfaction, $t(1, 54) = 5.80$, $p < .001$, Cohen's $d = 1.34$ and relatedness satisfaction, $t(1, 54) = 10.26$, $p < .001$, Cohen's $d = 1.03$, with the CTIC group reporting significantly greater competence ($M_{CTIC} = 4.44$, $M_{EIC} = 2.81$) and relatedness satisfaction ($M_{CTIC} = 6.15$, $M_{EIC} = 3.29$) than the EIC group. Competence frustration ($M_{CTIC} = 1.39$, $M_{EIC} = 3.28$), $t(1, 54) = 4.30$, $p < .001$, Cohen's $d = 1.60$ and relatedness frustration ($M_{CTIC} = 1.29$, $M_{EIC} = 2.79$), $t(1, 54) = 4.75$, $p < .001$, Cohen's $d = 1.16$ were both found to be significantly greater for the EIC group.

Demand and Resource Evaluations

An assessment of the balance between evaluations of situational demands and personal coping resources revealed a challenge appraisal for the CTIC group ($M_{CTIC} = .55$) and a threat appraisal for the EIC group ($M_{EIC} = 1.06$). An independent samples *t* test revealed significant differences in threat and challenge appraisals, $t(1, 54) = 4.68$, $p < .001$, $\eta^2 = .40$. Regarding demand and resource evaluations, there was a significant main effect for climate, $F(2, 53) = 21.96$, $p < .001$, $\eta^2 = .45$. Follow-up analyses revealed group differences for demand, $t(1, 54) = 4.71$, $p < .001$, Cohen's $d = 1.09$ and resource evaluations, $t(1, 54) = 3.45$, $p < .001$, Cohen's $d = 1.05$, with the EIC group reporting significantly greater demand evaluations ($M_{CTIC} = 2.89$, $M_{EIC} = 4.38$) and the CTIC reporting significantly greater resource evaluations ($M_{CTIC} = 5.34$, $M_{EIC} = 4.26$).

Affect

Examination of group differences in positive and negative affect during the juggling session, relative to baseline, revealed a significant main effect for climate, $F(2, 53) = 6.80$, $p = .002$, $\eta^2 = .20$, a main effect for time, $F(2, 53) = 5.50$, $p = .007$, $\eta^2 = .17$, and a significant Time × Climate interaction, $F(2, 53) = 14.06$, $p < .001$, $\eta^2 = .35$. Follow-up analyses revealed group differences for both positive, $t(1, 54) = 5.16$, $p < .001$, Cohen's $d = 0.77$, and negative affect, $t(1, 54) = 3.45$, $p < .001$, Cohen's $d = 0.71$, with the CTIC group reporting greater positive affect ($M_{CTIC} = 40.04$, $M_{EIC} = 29.37$) and the EIC group reporting greater negative affect ($M_{CTIC} = 14.00$, $M_{EIC} = 20.59$) during the instructional juggling session. Positive affect increased significantly for the CTIC group, from baseline, $t(1, 28) = 4.72$, $p < .001$, Cohen's $d = 1.19$, and negative affect increased significantly for participants in the EIC, $t(1, 26) = 3.17$, $p = .004$, Cohen's $d = 0.98$. There were no significant changes in negative affect for the CTIC group, $t(1, 28) = .98$, $p = .334$ or positive affect for the EIC group, $t(1, 26) = 1.93$, $p = .064$. There were no baseline differences in affect between groups, $F(2, 53) = 1.70$, $p = .193$.

Table 1 *M* (*SD*), Cohen's *d*, and Scales for Affect, Basic Psychological Need Satisfaction and Frustration, Demand and Resource Evaluations, Psychosocial Stress Items, and Perceived Ability to Juggle Items by Motivational Climate

Variable	Cohen's *d* (group differences)	CTIC group	EIC group	Scale
Pre–post variables				
Affect				
Prepositive affect		29.59 (7.21)[b]	33.07 (7.50)	(10–50)
Postpositive affect	1.38	40.04 (7.03)[a,b]	29.37 (8.41)[a]	(10–50)
Prenegative affect		15.34 (4.74)	14.63 (4.87)[c]	(10–50)
Postnegative affect	0.93	14.00 (5.39)[a]	20.59 (8.45)[a,c]	(10–50)
Post only variables				
Basic psychological needs				
Competence satisfaction	1.82	4.44 (0.77)[a]	2.81 (1.00)[a]	(1–7)
Competence frustration	1.16	1.39 (0.84)[a]	3.28 (2.14)[a]	(1–7)
Relatedness satisfaction	2.75	6.15 (0.86)[a]	3.29 (1.19)[a]	(1–7)
Relatedness frustration	1.28	1.29 (0.82)[a]	2.79 (1.44)[a]	(1–7)
Demand and resource evaluations				
Demands	1.26	2.89 (0.89)[a]	4.38 (1.22)[a]	(1–7)
Resources	0.91	5.34 (0.87)[a]	4.26 (1.26)[a]	(1–7)
Threat/challenge appraisals	1.26	0.55 (0.19)[a] *Challenge appraisal*	1.06 (0.54)[a] *Threat appraisal*	>1 *threat appraisal* <1 *challenge appraisal*
Individual items				
Psychosocial stress				
Shame	1.59	1.31 (1.04)[a]	3.89 (2.04)[a]	(1–7)
Humiliation	1.40	1.24 (0.79)[a]	3.40 (2.04)[a]	(1–7)
Embarrassment	1.59	1.14 (0.44)[a]	3.22 (1.80)[a]	(1–7)
Self-consciousness	1.02	1.86 (1.60)[a]	3.74 (2.07)[a]	(1–7)
Perceived ability to juggle				
Number can juggle	1.13	2.52 (0.51)[a]	1.85 (0.66)[a]	(1–3)
Juggling confidence	0.80	2.66 (1.11)[a]	1.81 (1.00)[a]	(1–5)

Note. CTIC = caring, task-involving climate; EIC = ego-involving climate.
Same subscripts note significant differences between groups (i.e., CTIC vs. EIC) at $p < .001$ for [a] and $p < .005$ for and within groups (i.e., pre to post) at $p < .001$ for [b] and $p < .005$ for[c].

Table 2 Correlation Table Among Motivational Climate, IL-6 Levels, Psychosocial Stress Items, and Psychosocial Stressors

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Caring climate	1	.57**	−.09	.26	.17	.29	.20	−.09	−.28	−.12	−.17	−.32	−.09	−.01	−.25
2. Task climate	.72**	1	.30	.03	−.02	.05	.18	.07	.13	.25	.16	.14	−.08	.08	.03
3. Ego climate	−.19	−.20	1	−.08	−.06	−.06	.08	.46*	.12	.53**	.48*	.59**	−.10	.41*	.28
4. IL-6 baseline	−.03	−.11	.51**	1	.90**	.75**	.59**	.09	−.27	−.09	.03	−.20	.14	.30	−.09
5. IL-6 + 30 min	−.11	−.23	.49**	.73**	1	.87**	.79**	.12	−.21	.03	.11	−.08	.06	.31	−.27
6. IL-6 + 45 min	−.11	−.25	.01	.35	.51**	1	.91**	.20	−.07	.13	.15	−.08	.13	.34	−.24
7. IL-6 + 60 min	−.17	−.22	.05	.23	.54**	.73**	1	.28	.17	.40	.34	.11	.20	.46*	−.27
8. Shame	−.75**	−.52**	.01	−.00	−.07	−.13	−.09	1	.56**	.76**	.82**	.81**	.22	.53**	.37
9. Humiliated	−.14	−.17	.57**	.21	.06	−.12	−.11	.17	1	.77**	.69**	.62**	.42*	.41*	.25
10. Embarrassed	−.31	−.14	.62**	.34	.39*	.05	−.03	.22	.62**	1	.89**	.80**	.27	.67**	.36
11. Self-conscious	−.11	.12	.46*	.04	.09	−.17	−.16	.26	.37*	.43*	1	.85**	.34	.67**	.49**
12. Stress	−.23	−.24	.62**	.16	.07	−.18	−.18	.30	.68**	.45*	.35	1	.15	.54**	.38*
13. Negative evaluation instructors	−.57**	−.41*	.42*	.31	.26	−.09	−.10	.56**	.53**	.75**	.27	.53**	1	.35	.43*
14. Peer judgment	−.14	.13	.24	−.06	−.07	−.29	−.30	.26	.24	.42*	.78**	.17	.47*	1	.17
15. No control	−.41*	−.25	.40*	.09	.07	−.12	−.16	.40*	.41*	.56**	.09	.37*	.61**	.22	1

Note. Caring, task-involving climate below diagonal, ego-involving climate above diagonal. IL-6 = interleukin-6.
*$p < .05$. **$p < .01$.

Table 3 Correlation Table Among Motivational Climate and Post-Juggling-Session Psychological Responses and Cronbach's Alphas

	1	2	3	4	5	6	7	8	9	10	11
1. Caring climate	1	.57**	−.09	.23	−.04	.20	−.04	−.47*	−.01	.25	−.38
2. Task climate	.72**	1	.30	.21	.33	.08	.03	−.14	.20	.02	−.08
3. Ego climate	−.19	−.20	1	.07	.44*	−.29	.10	.51**	.41*	.23	.45*
4. Competence satisfaction	.40*	.24	.11	1	−.44*	−.14	−.30	−.05	.39*	.46*	−.10
5. Competence frustration	−.34	−.28	.11	−.45*	1	−.06	.44*	.42*	.35	−.24	.43*
6. Relatedness satisfaction	.57**	.52**	−.18	.51**	−.69**	1	−.25	−.20	−.36	−.16	−.17
7. Relatedness frustration	−.64**	−.49**	.02	−.50**	.76**	−.68**	1	.31	−.03	−.06	.34
8. Demand evaluations	−.15	−.22	.32	−.05	.25	−.06	.19	1	.34	−.13	.67**
9. Resource evaluations	.30	.25	.28	.73**	−.21	.33	−.31	.07	1	.43*	.22
10. Positive affect	.57**	.51**	.03	.52**	−.33	.62**	−.44*	−.12	.53**	1	.00
11. Negative affect	−.09	−.07	.12	.05	.03	−.10	−.07	.20	−.20	−.40*	1
Cronbach's alpha	.98	.88	.93	.96	.98	.93	.91	.80	.71	.90	.90

Note. Caring, task-involving climate below diagonal, ego-involving climate above diagonal.
*$p < .05$. **$p < .01$.

Individual Psychological Items

Psychosocial Stressors. There were group differences in participants' experiences of stress and feeling negatively evaluated by the instructors, judged by peers, and that they did not have control over their own success, $F(4, 51) = 27.15$, $p < .001$, $\eta^2 = .680$. Specifically, the EIC participants reported experiencing much more stress ($M_{CTIC} = 1.79$, $M_{EIC} = 3.85$), $t(1, 54) = 4.31$, $p < .001$, Cohen's $d = 1.75$; negative evaluation from instructors ($M_{CTIC} = 1.21$, $M_{EIC} = 5.04$), $t(1, 54) = 9.74$, $p < .001$, Cohen's $d = 1.43$; judgment from peers ($M_{CTIC} = 1.59$, $M_{EIC} = 4.48$), $t(1, 54) = 4.33$, $p < .001$, Cohen's $d = 1.17$; and that they had less control over their own success ($M_{CTIC} = 1.66$, $M_{EIC} = 3.56$), $t(1, 54) = 3.35$, $p < .001$, Cohen's $d = 1.88$, during the instructional juggling session.

Psychosocial Stress Responses. Results indicate the EIC participants experienced significantly more psychosocial stress compared to those in the CTIC, $F(4, 51) = 11.48$, $p < .001$, $\eta^2 = .47$. Specifically, participants in the EI group reported experiencing more shame ($M_{CTIC} = 1.31$, $M_{EIC} = 3.89$), $t(1, 54) = 5.89$, $p < .001$, Cohen's $d = 1.60$, humiliation ($M_{CTIC} = 1.24$, $M_{EIC} = 3.40$), $t(1, 54) = 5.16$, $p < .001$, Cohen's $d = 1.53$, embarrassment ($M_{CTIC} = 1.14$, $M_{EIC} = 3.22$), $t(1, 54) = 5.84$, $p < .001$, Cohen's $d = 1.29$, and self-consciousness ($M_{CTIC} = 1.86$, $M_{EIC} = 3.74$), $t(1, 54) = 3.79$, $p < .001$, Cohen's $d = 1.84$.

Psychological Appraisals of Ability to Juggle and Confidence to Juggle. Results from a MANOVA indicate there were significant group differences in psychological appraisals of ability and confidence in juggling, $F(2, 53) = 9.09$, $p < .001$, $\eta^2 = .26$. Specifically, follow-up analyses revealed the CTIC group reported they felt that they could juggle more balls at once after the session ($M_{CTIC} = 2.52$, $M_{EIC} = 1.85$), $t(1, 54) = 4.23$, $p < .001$, Cohen's $d = 0.59$ and had more confidence in their ability to juggle three balls consecutively while observed ($M_{CTIC} = 2.66$, $M_{EIC} = 1.81$), $t(1, 54) = 2.97$, $p < .001$, Cohen's $d = 1.06$, compared with participants in the EIC group.

Discussion

The primary purpose of the current investigation was to experimentally investigate whether the perceived motivational climate in an achievement context triggers a psychologically induced inflammatory response. This is the first investigation to show that EICs can elicit a rise in salivary IL-6, a pro-inflammatory cytokine, likely a physiological response to psychosocial stressors present in EICs including negative evaluation from instructors, judgment from peers, and feeling as though one does not have control over their own success. In support of this assertion, participants in the EIC group reported experiencing each of these very stressors to a greater extent than participants in the CTIC group. The EIC group also reported experiencing more self-conscious emotional responses including heightened feelings of shame, humiliation, embarrassment, and self-consciousness. Such self-conscious emotions, in particular shame, are potent elicitors of physiological stress responses, including both cortisol and inflammation which, while adaptive in the short term, can compromise mental and physical health with recurrent or chronic exposure (Dickerson, 2021).

Dickerson (2021) postulates that humans are wired to seek belonging and social acceptance of others and that when the potential for evaluation or rejection occurs, this threatens those social bonds. She has explained how feeling critically evaluated and judged by others based on characteristics that are valued (e.g., athletic capabilities) and feeling as though one cannot succeed despite their best efforts (i.e., uncontrollability) are more menacing social-evaluative threats that reliably incite concerning emotional, physiological, and behavioral responses—particularly when the evaluative others are physically present to observe one's performance (Dickerson, Gruenewald, et al., 2004; Dickerson & Kemeny, 2004). I argue that these very threats (i.e., negative evaluation and uncontrollability) are characteristic of EICs and that as a result, the coordinated emotional, physiological, and behavioral response identified by social self-preservation theory may well be commonplace for individuals exposed to highly EICs, although more research in real-world contexts is needed. This coordinated response includes negatively valenced self-conscious emotions such as shame and embarrassment, elevated cortisol and inflammation, as well as submissive behavioral responses including withdrawal from social activities.

The current experimental investigation corroborates previous research that has provided evidence indicating EICs may elicit feelings of shame, humiliation, embarrassment, and self-consciousness in performance settings (Hogue et al., 2013, 2017, 2021). Furthermore, although this is the first study show that EICs can trigger a rise in inflammation, there have been multiple experimental investigations where EICs elicited a rise in salivary cortisol (Breske et al., 2017; Hogue, 2019, 2020; Hogue et al., 2013, 2017, 2021) suggesting cortisol may be reliably triggered by an EIC. Finally, regarding the predicted behavioral responses identified by social self-preservation theory, unpublished qualitative data from the current investigation linked EICs to submissive behavioral responses including choosing to disengage from the activity, intentionally putting forth low effort, looking down and away from instructors and peers, and describing their own and their peers body language as "shrinking" or "hiding away" (Wise et al., 2022). In none of the aforementioned experimental investigations did CTICs trigger these same responses.

According to the stress buffering hypothesis, social support helps protect against more adverse stress responses. Cohen and Pressman (2004) postulate that social support may protect against stress by attenuating or preventing a (negative) stress appraisal. Although Cohen and Pressman were referencing major life stressors, their explanation may also help explain why participants in the CTIC group in the current investigation reported a challenge appraisal of stress, where resource evaluations outweighed demand evaluations, while the EIC group reported a threat appraisal (demand evaluations outweigh resource evaluations), despite both groups experiencing performance stress during the instructional juggling session. The social support provided by instructors and fostered among participants in the CTIC group may have led to greater resource evaluations. For instance, it may be that experiencing encouragement and support from others resulted in participants believing that they were performing well, that they had the abilities to perform well, and that learning to juggle was a positive challenge for them (all resources). Likewise, utilizing effort and improvement as markers of success and highlighting that everyone learns at a different pace in the CTIC session may have helped the participants define "performing well" as improving, persisting, and working past mistakes. Cohen and Pressman also shared the following explanation for why social support may yield protective responses to stress, "support beliefs may reduce or eliminate the affective reaction to a stressful event,

dampen physiological responses to the event, or prevent or alter maladaptive behavioral responses" (p. 782). Thus, social support may also help explain the significantly greater positive affect and lower negative affect reported by participants in the CTIC group.

I would also argue that CTICs are void of the more menacing psychosocial stressors identified by social self-preservation theory (i.e., critical social evaluation and uncontrollability). By definition, leaders in CTICs aim to foster a sense of belonging and to create an environment where participants are made to feel welcome, cared for, and accepted—each of which would aid participants in experiencing the belonging and acceptance that Dickerson argued is fundamental to the human experience. Likewise, feedback is self-referenced in CTICs. Also relevant, in CTICs when a participant is asked to provide feedback to or demonstrate a skill for another participant, it is typically to create a cooperative learning environment where all participants can learn from one another, not to judge or compare their skills as is often the case in an EIC. As a result, this may help curb negative evaluation in CTICs, replacing it with a more positive, supportive approach toward coaching. Finally, in CTICs, participants are encouraged to utilize effort and improvement as markers of success—both of which are under each participant's control. In sum, the psychosocial factors shown to trigger an adverse coordinated response seem to be minimized in CTICs. It should be noted, however, that because the condition was caring and task-involving, there can be no certainty regarding which particular climate may have led to these outcomes. With respect to the practical application of this body of work, best practice is to create a highly caring and task-involving climate.

Regarding one's ability to cope with performance stress, there is evidence from this investigation that suggests CTICs may help set participants up to perform better and to have a more positive, fulfilling experience in achievement settings. For instance, in addition to the high levels of positive affect reported by the CTIC group, the CTIC participants also reported significantly greater relatedness and competence satisfaction. In contrast, participants in the EIC reported significantly greater relatedness and competence frustration, suggesting the actions of the EIC leaders not only did not fulfill these needs but they resulted in the participants feeling less capable and less connected to others. Since there is evidence that the relationship between task-involving climates and competence satisfaction hold in sport settings (Abraldes et al., 2022; Elsborg et al., 2023), it would interesting to examine the relationship between caring climates and relatedness fulfillment.

It is important to note that this was just a brief 30-min experimental manipulation with a climate that is milder than many real-world performance contexts (e.g., sport). It may be that prolonged exposure elicits more robust responses or, on the contrary, that athletes' mental skills protect them against the more concerning responses found in the current investigation. There is some experimental research that suggests when athletes are encouraged to create a CTIC among their teammates and to focus on effort and improvement as markers of success (i.e., adopt a task-orientation), this can elicit more protective psychophysiological stress responses to an EIC (Hogue, 2020). It may also be worth considering whether other forms of mental skills training would lead to less deleterious responses in EICs.

Another important limitation to consider is that this was an instructional juggling session and a requirement for accepted participants was that they did not yet know how to juggle. As a result, the very design of the study may have led to the greater self-perceived ability to juggle in the CTIC group than would have been found in a real-world context. It may be, for instance, that in a prolonged learning context such as over the course of a semester long physical education class, that potential differences in perceived abilities would not be as salient over time. Likewise, because physical exertion can trigger an inflammatory response, which is typically adaptive, it may be that elevated IL-6 is better regulated in sport or other physical activity-based settings. Similar arguments could be made regarding the affective responses of participants who engage in considerable levels of physical activity. Also, there was only a single marker of inflammation in the current investigation. Future research should consider including a number of pro- and anti-inflammatory cytokines. For example, a recent systematic review and meta-analysis of salivary markers of inflammation that respond to acute psychological stress found that, in addition to IL-6, IL-10, tumor necrosis factor alpha, and INF-γ are also responsive (Slavish & Szabo, 2019).

Although experimental investigations can provide support for causal inference, additional limitations should be considered. For instance, longitudinal investigations are essential in order to confirm directional effects in real-world settings. Also, experimental investigations generally lack strong external validity. To counter this, many steps were taken. For instance, the instructors were trained to dress, speak, and act like coaches. Likewise, the climate manipulation took place in a small gym space. Nevertheless, the participants were obviously aware this was an experiment. Finally, although there is some evidence linking EICs to shame in physical education (Hogue et al., 2019), these associations need to be examined further in real-world, nonexperimental settings.

With regard to mental skills training, researchers and practitioners would likely be interested in understanding how athletes can better protect themselves against psychological environments that trigger a rise in cortisol and inflammation (e.g., EICs), as participants do not always have control over the type of environment they are placed in. For instance, Mehrsafar et al. (2019) were able to show that an 8-week mindfulness-based intervention can decrease stress-related salivary cortisol in elite athletes. These results and the current investigation both suggest that mental skills and the motivational climate may impact psychophysiological responses to performance stress. Moreover, in the current investigation, the variability (*SD*s) in the EIC results suggests that some participants did not respond as negatively as others to the EIC. This suggests that there may be personality features or mental skills that protected some participants from the more deleterious outcomes that may ensue after exposure to an EIC. Also, identifying physiological responses to the perceived motivational climate in physical activity-based settings is pivotal to understanding the mechanistic pathway linking motivational climates to health and performance outcomes for athletes. Finally, it may also be important to understand which contextual variables (e.g., interpersonal comparisons) engender more malignant responses.

To conclude, these findings suggest CTICs help safeguard against more noxious psychosocial threats during motivated performance tasks that take place in the presence of others. Participants in the CTICs reported marginal levels of self-conscious emotions and a challenge stress appraisal, with no changes in IL-6 levels during a socially evaluated performance task. This suggests the participants did not experience "explicit exclusion, scorn, or rejection" and they felt they had the capabilities necessary to meet performance expectations. Their reports of heightened competence need fulfillment also suggest the psychosocial environment was empowering in that the participants felt they were capable, skilled, and could overcome challenges. Likewise, the

high levels of relatedness reported by the CTIC participants indicate the environment led them to feel they were supported and accepted by others around them. These were not the experiences of the EIC participants. Finally, the CTIC group shared that they felt they would be more skilled at juggling in front of others and were more confident in their juggling ability, compared with the EIC group. Collectively, this research provides a more nuanced understanding of the type of motivational climate that helps set participants up to better manage performance stress, develop their skills, and have a positive experience in achievement contexts.

Acknowledgments

This research was funded by Penn State Harrisburg's Office of Research and Outreach. The author would like to thank the following students for their assistance with the project: Kyla Wise, Elizabeth Kenney, Kristen Guarneschelli, Tiffany Simmers, Matthew Moeller, Greg Jacobs, Emily Barb, Austin Warren, Shianna Ace, Aaron Cummings, Lizbeth Guartan, Trevor Kisler, and Daniel Morris.

References

Abraldes, J.A., Conte Marín, L., Manzano-Sánchez, D., Gómez-López, M., & Sánchez-Alcaraz, B.J. (2022). A cluster analysis of high-performance female team players' perceived motivational climate: Implications on perceived motor competence and autonomous behaviour. *PLoS One, 17*(12), Article 572. https://doi.org/10.1371/journal.pone.0278572

Akinola, M., Fridman, I., Mor, S., Morris, M.W., & Crum, A.J. (2016). Adaptive appraisals of anxiety moderate the association between cortisol reactivity and performance in salary negotiations. *PLoS One, 11*(12), Article 977. https://doi.org/10.1371/journal.pone.0167977

Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology, 84*(3), 261–271. https://doi.org/10.1037/0022-0663.84.3.261

Back, J., Johnson, U., Svedberg, P., McCall, A., & Ivarsson, A. (2022). Drop-out from team sport among adolescents: A systematic review and meta-analysis of prospective studies. *Psychology of Sport and Exercise, 61*(1), Article 205. https://doi.org/10.1016/j.psychsport.2022.102205

Bhavsar, N., Bartholomew, K.J., Quested, E., Gucciardi, D.F., Thøgersen-Ntoumani, C., Reeve, J., Sarrazin, P., & Ntoumanis, N. (2020). Measuring psychological need states in sport: Theoretical considerations and a new measure. *Psychology of Sport and Exercise, 47*(1), Article 617. https://doi.org/10.1016/j.psychsport.2019.101617

Bower, J.E., & Kuhlman, K.R. (2023). Psychoneuroimmunology: An introduction to immune-to-brain communication and its implications for clinical psychology. *Annual Review of Clinical Psychology, 19*(1), 331–359. https://doi.org/10.1146/annurev-clinpsy-080621-045153

Breske, M.P., Fry, M.D., Fry, A.C., & Hogue, C.M. (2017). The effects of goal priming on cortisol responses in an ego-involving climate. *Psychology of Sport and Exercise, 32*(1), 74–82. https://doi.org/10.1016/j.psychsport.2017.06.001

Cassel, J. (1976). The contribution of the social environment to host resistance: The fourth wade Hampton frost lecture. *American Journal of Epidemiology, 104*(2), 107–123. https://doi.org/10.1093/oxfordjournals.aje.a112281

Chamberlin, J.M., Fry, M.D., & Iwasaki, S. (2017). High school athletes' perceptions of the motivational climate in their off-season training programs. *The Journal of Strength & Conditioning Research, 31*(3), 736–742. https://doi.org/10.1519/JSC.0000000000001533

Cobb, S. (1976). Social support as a moderator of life stress. *Psychosomatic Medicine, 38*(5), 300–314.

Cohen, S., Janicki-Deverts, D., Doyle, W.J., Miller, G.E., Frank, E., Rabin, B.S., & Turner, R.B. (2012). Chronic stress, glucocorticoid receptor resistance, inflammation, and disease risk. *Proceedings of the National Academy of Sciences, 109*(16), 5995–5999. https://doi.org/10.1073/pnas.1118355109

Cohen, S., & McKay, G. (1984). Social support, stress, and the buffering hypothesis: A theoretical analysis. *Handbook of Psychology and Health, 4,* 253–267.

Cohen, S., & Pressman, S. (2004). Stress-buffering hypothesis. In N. Anderson (Ed.), *Encyclopedia of health & behavior* (pp. 780–782). Sage.

Cohen, S., & Wills, T.A. (1985). Stress, social support, and the buffering hypothesis. *Psychological Bulletin, 98*(2), 310–357. https://doi.org/10.1037/0033-2909.98.2.310

Crum, A.J., Akinola, M., Martin, A., & Fath, S. (2017). The role of stress mindset in shaping cognitive, emotional, and physiological responses to challenging and threatening stress. *Anxiety, Stress, & Coping, 30*(4), 379–395. https://doi.org/10.1080/10615806.2016.1275585

Crum, A.J., Jamieson, J.P., & Akinola, M. (2020). Optimizing stress: An integrated intervention for regulating stress responses. *Emotion, 20*(1), 120–125. https://doi.org/10.1037/emo0000670

Deci, E.L., & Ryan, R.M. (1985). *Intrinsic motivation and self-determination in human behavior*. Plenum.

Deci, E.L., & Ryan, R.M. (2012). Motivation, personality, and development within embedded social contexts: An overview of self-determination theory. In R.M. Ryan (Ed.), *The Oxford handbook of human motivation* (pp. 85–107). Oxford University Press.

Dickerson, S.S. (2021). Social-evaluative threat. In R.H. Paul, L.E. Salminen, J. Heaps, & L.M. Cohen (Eds.), *The Wiley encyclopedia of health psychology* (Vol. 2, pp. 641–647). Wiley. https://doi.org/10.1002/9781119057840.ch115

Dickerson, S.S., Gable, S.L., Irwin, M.R., Aziz, N., & Kemeny, M.E. (2009). Social-evaluative threat and proinflammatory cytokine regulation an experimental laboratory investigation. *Psychological Science, 20*(10), 1237–1244. https://doi.org/10.1111/j.1467-9280.2009.02437.x

Dickerson, S.S., Gruenewald, T.L., & Kemeny, M.E. (2004). When the social self is threatened: Shame, physiology, and health. *Journal of Personality, 72*(6), 1191–1216. https://doi.org/10.1111/j.1467-6494.2004.00295.x

Dickerson, S.S., Gruenewald, T.L., & Kemeny, M.E. (2009). Psychobiological responses to social self threat: Functional or detrimental? *Self and Identity, 8*(2–3), 270–285. https://doi.org/10.1080/15298860802505186

Dickerson, S.S., & Kemeny, M.E. (2004). Acute stressors and cortisol responses: A theoretical integration and synthesis of laboratory research. *Psychological Bulletin, 130*(3), 355–391. https://doi.org/10.1037/0033-2909.130.3.355

Dickerson, S.S., Kemeny, M.E., Aziz, N., Kim, K.H., & Fahey, J.L. (2004). Immunological effects of induced shame and guilt. *Psychosomatic Medicine, 66*(1), 124–131. https://doi.org/10.1097/01.PSY.0000097338.75454.29

Dickerson, S.S., Mycek, P.J., & Zaldivar, F. (2008). Negative social evaluation, but not mere social presence, elicits cortisol responses to a laboratory stressor task. *Health Psychology, 27*(1), 116–121. https://doi.org/10.1037/0278-6133.27.1.116

Duda, J.L., & Appleton, P.R. (2016). Empowering and disempowering coaching climates: Conceptualization, measurement considerations, and intervention implications. In M. Raab, R. Wyllemanm, A. Seiler, & A.H. Elbe (Eds.), *Sport and exercise psychology research: From theory to practice* (pp. 373–388). Academic Press. https://doi.org/10.1016/B978-0-12-803634-1.00017-0

Dweck, C.S. (1986). Motivational processes affecting learning. *American Psychologist, 41*(10), 1040–1048.

Eisenberger, N., & Moieni, M. (2020). Inflammation affects social experience: Implications for mental health. *World Psychiatry, 19*(1), 109–110. https://doi.org/10.1002/wps.20724

Elenkov, I.J., Iezzoni, D.G., Daly, A., Harris, A.G., & Chrousos, G.P. (2005). Cytokine dysregulation, inflammation and well-being. *Neuroimmunomodulation, 12*(5), 255–269. https://doi.org/10.1159/000087104

Elsborg, P., Appleton, P., Wikman, J.M., & Nielsen, G. (2023). The associations between motivational climate, basic psychological needs and dropout in volleyball—A comparison across competitive levels. *European Journal of Sport Science, 23*(3), 393–403. https://doi.org/10.1080/17461391.2022.2041100

Fry, M.D., & Gano-Overway, L.A. (2010). Exploring the contribution of the caring climate to the youth sport experience. *Journal of Applied Sport Psychology, 22*(3), 294–304. https://doi.org/10.1080/10413201003776352

Fry, M.D., Gano-Overway, L.A., Guivernau, M.R., Kim, M.S., & Newton, M. (2020). *A coach's guide to maximizing the youth sport experience: Work hard, be kind*. Routledge.

Fry, M.D., Guivernau, M.R., Kim, M.S., Newton, M.L., Gano–Overway, L.A., & Magyar, T.M. (2012). Youth perceptions of a caring climate, emotional regulation, and psychological well-being. *Sport, Exercise, and Performance Psychology, 1*(1), 44–57. https://doi.org/10.1037/a0025454

Fry, M.D., & Hogue, C.M. (2018). Psychological considerations for children and adolescents in sport and performance. In O. Braddick (Ed.), *Oxford research encyclopedia of psychology* (pp. 1–27). Oxford University Press. https://doi.org/10.1093/acrefore/9780190236557.013.177

Fry, M.D., Hogue, C.M., Iwasaki, S., & Solomon, G.B. (2021). The relationship between the perceived motivational climate in elite collegiate sport and athlete psychological coping skills. *Journal of Clinical Sport Psychology, 15*(4), 334–350. https://doi.org/10.1123/jcsp.2020-0002

Fry, M.D., & Moore, E.W.G. (2019). Motivation in sport: Theory and application. In M.H. Anshel(Ed.), T. Petrie, E. Labbe, S. Petruzello, & J. Steinfeldt (Eds.), *APA handbook of sport and exercise psychology* (pp. 273–299). American Psychological Association.

Fry, M.D., Wineinger, T.O., Long, H., Guivernau, M., Gano-Overway, L.A., & Iwasaki, S. (2023). The influence of climate on flourishing and motivational outcomes for U.S. Masters Swimmers. *International Journal of Environmental Research and Public Health, 20,* Article 1990. https://doi.org/10.3390/ijerph20031990

Gano-Overway, L.A., & Carson Sackett, S. (2021). The Mapp way: Success through combining the motivational and caring climates. *Journal of Applied Sport Psychology, 33*(2), 238–258. https://doi.org/10.1080/10413200.2019.1647476

Gano-Overway, L.A., & Peterson, M.C. (2023). Connections between caring climate, self-compassion, self-pity, and reactions to an emotionally difficult sport situation. *Psychology of Sport and Exercise, 67*(1), Article 428. https://doi.org/10.1016/j.psychsport.2023.102428

García-González, L., Sevil-Serrano, J., Abós, A., Aelterman, N., & Haerens, L. (2019). The role of task and ego-oriented climate in explaining students' bright and dark motivational experiences in physical education. *Physical Education and Sport Pedagogy, 24*(4), 344–358. https://doi.org/10.1080/17408989.2019.1592145

Gould, D., Flett, R., & Lauer, L. (2012). The relationship between psychosocial developmental and the sports climate experienced by underserved youth. *Psychology of Sport and Exercise, 13*(1), 80–87. https://doi.org/10.1016/j.psychsport.2011.07.005

Gruenewald, T.L., Dickerson, S.S., & Kemeny, M.E. (2007). A social function for self-conscious emotions: The social self preservation theory. In J. Tracy, R.W. Robins, & J.P. Tangney (Eds.), *The self-conscious emotions: Theory and research* (pp. 68–87). Guilford Press.

Gruenewald, T.L., Kemeny, M.E., Aziz, N., & Fahey, J.L. (2004). Acute threat to the social self: Shame, social self-esteem, and cortisol activity. *Psychosomatic Medicine, 66*(6), 915–924. https://doi.org/10.1097/01.psy.0000143639.61693.ef

Harvey, S., Gano-Overway, L., Baghurst, T., Blom, L., & Eisenmann, J. (2023). 50 Million Strong ™: The contribution of sports coaching. *Research Quarterly for Exercise and Sport, 94*(2), 310–321. https://doi.org/10.1080/02701367.2021.1976715

Harwood, C.G., Keegan, R.J., Smith, J.M.J., & Raine, A.S. (2015). A systematic review of the intrapersonal correlates of motivational climate perceptions in sport and physical activity. *Psychology of Sport and Exercise, 18*(1), 9–25. https://doi.org/10.1016/j.psychsport.2014.11.005

Hase, A., O'Brien, J., Moore, L.J., & Freeman, P. (2019). The relationship between challenge and threat states and performance: A systematic review. *Sport, Exercise, and Performance Psychology, 8*(2), 123–144. https://doi.org/10.1037/spy0000132

Heinrichs, M., Baumgartner, T., Kirschbaum, C., & Ehlert, U. (2003). Social support and oxytocin interact to suppress cortisol and subjective responses to psychosocial stress. *Biological Psychiatry, 54*(12), 1389–1398. https://doi.org/10.1016/S0006-3223(03)00465-7

Hogue, C.M. (2019). The protective impact of a mental skills training session and motivational priming on participants' psychophysiological responses to performance stress. *Psychology of Sport and Exercise, 45*, 101574. https://doi.org/10.1016/j.psychsport.2019.101574

Hogue, C.M. (2020). Achievement goal theory-based psychological skills training session buffers youth athletes' psychophysiological responses to performance stress. *Psychology of Sport and Exercise, 51,* 101792. https://doi.org/10.1016/j.psychsport.2020.101792

Hogue, C.M., Fry, M.D., & Fry, A.C. (2017). The differential impact of motivational climate on adolescents' psychological and physiological stress responses. *Psychology of Sport and Exercise, 30*(1), 118–127. https://doi.org/10.1016/j.psychsport.2017.02.004

Hogue, C.M., Fry, M.D., & Fry, A.C. (2021). The protective impact of learning to juggle in a caring, task-involving climate versus an ego-involving climate on participants' inflammation, cortisol, and psychological responses. *International Journal of Sport and Exercise Psychology, 19*(4), 650–667. https://doi.org/10.1080/1612197X.2019.1696868

Hogue, C.M., Fry, M.D., Fry, A.C., & Pressman, S.D. (2013). The influence of a motivational climate intervention on participants' salivary cortisol and psychological responses. *Journal of Sport and Exercise Psychology, 35*(1), 85–97. https://doi.org/10.1123/jsep.35.1.85

Hogue, C.M., Fry, M.D., & Iwasaki, S. (2019). The impact of the perceived motivational climate in physical education classes on adolescent greater life stress, coping appraisals, and experience of shame. *Sport, Exercise, and Performance Psychology, 8*(3), 273–289. https://doi.org/10.1037/spy0000153

Iwasaki, S., & Fry, M.D. (2016). Female adolescent soccer players' perceived motivational climate, goal orientations, and mindful engagement. *Psychology of Sport and Exercise, 27*(1), 222–231. https://doi.org/10.1016/j.psychsport.2016.09.002

Izawa, S., Miki, K., Liu, X., & Ogawa, N. (2013). The diurnal patterns of salivary interleukin-6 and C-reactive protein in healthy young adults. *Brain, Behavior, and Immunity, 27*(1), 38–41. https://doi.org/10.1016/j.bbi.2012.07.001

Izawa, S., Sugaya, N., Kimura, K., Ogawa, N., Yamada, K.C., Shirotsuki, K., Mikami, I., Hirata, K., Nagano, Y., & Nomura, S. (2013). An increase in salivary interleukin-6 level following acute psychosocial stress and its biological correlates in healthy young adults. *Biological Psychology, 94*(2), 249–254. https://doi.org/10.1016/j.biopsycho.2013.06.006

Kemeny, M.E., Gruenewald, T.L., & Dickerson, S.S. (2004). Shame as the emotional response to threat to the social self: Implications for behavior, physiology, and health. *Psychological Inquiry, 15*(2), 153–160. http://www.jstor.org/stable/20447221

Lovallo, W.R. (2016). *Stress and health: Biological and psychological interactions*. SAGE.

Maier, K.J., Waldstein, S.R., & Synowski, S.J. (2003). Relation of cognitive appraisal to cardiovascular reactivity, affect, and task engagement. *Annals of Behavioral Medicine, 26*(1), 32–41. https://doi.org/10.1207/S15324796ABM2601_05

Man, I.S.C., Shao, R., Hou, W.K., Xin Li, S., Liu, F.Y., Lee, M., Wing, Y.K., Yau, S., & Lee, T.M. (2023). Multi-systemic evaluation of biological and emotional responses to the Trier social stress test: A meta-analysis and systematic review. *Frontiers in Neuroendocrinology, 68*, 101050. https://doi.org/10.1016/j.yfrne.2022.101050

Marsland, A.L., Walsh, C., Lockwood, K., & John-Henderson, N.A. (2017). The effects of acute psychological stress on circulating and stimulated inflammatory markers: A systematic review and meta-analysis. *Brain, Behavior, and Immunity, 64*(1), 208–219. https://doi.org/10.1016/j.bbi.2017.01.011

Martin, J.J., Byrd, B., Garn, A., McCaughtry, N., Kulik, N., & Centeio, E. (2016). Predicting social responsibility and belonging in urban after-school physical activity programs with underserved children. *Urban Review, 48*(3), 403–418. https://doi.org/10.1007/s11256-016-0360-2

Mehrsafar, A.H., Strahler, J., Gazerani, P., Khabiri, M., Sánchez, J.C.J., Moosakhani, A., & Zadeh, A.M. (2019). The effects of mindfulness training on competition-induced anxiety and salivary stress markers in elite Wushu athletes: A pilot study. *Physiology and Behavior, 210*(1), 1–10. https://doi.org/10.1016/j.physbeh.2019.112655

Mendes, W.B., Blascovich, J., Major, B., & Seery, M. (2001). Challenge and threat responses during downward and upward social comparisons. *European Journal of Social Psychology, 31*(5), 477–497. https://doi.org/10.1002/ejsp.80

Mendes, W.B., Gray, H.M., Mendoza-Denton, R., Major, B., & Epel, E.S. (2007). Why egalitarianism might be good for your health: Physiological thriving during stressful intergroup encounters. *Psychological Science, 18*(11), 991–998. https://doi.org/10.1111/j.1467-9280.2007.02014.x

Miller, G.E., Cohen, S., & Ritchey, A.K. (2002). Chronic psychological stress and the regulation of pro-inflammatory cytokines: A glucocorticoid-resistance model. *Health Psychology, 21*(6), 531–541. https://doin.org/10.1037//0278-6133.21.6.531

Newton, M.L., Fry, M.D., Watson, D.L., Gano-Overway, L.A., Kim, M.S., Magyar, M.T., & Guivernau, M.R. (2007). Psychometric properties of the caring climate scale in a physical activity setting. *Revista de Psicología Del Deporte, 16*(1), 67–84.

Nicholls, J.G. (1984). Achievement motivation: Conceptions of ability, subjective experience, task choice, and performance. *Psychological Review, 91*(3), 328–346. https://doi.org/10.1037/0033-295X.91.3.328

Nicholls, J.G. (1989). *The competitive ethos and democratic education*. Harvard University Press.

Noddings, N. (2003a). *Happiness and education*. University of Cambridge.

Noddings, N. (2003b). *Caring: A feminine approach toethics & moral education*. University of California.

Noddings, N. (2003c). *Happiness and education*. University of Cambridge. http://dx.doi.org/10.1017/CBO9780511499920

Noddings, N. (2015). *The challenge to care in school: An alternative approach to education* (2nd ed.). Teachers College Press.

Noddings, N. (2015). *The challenge to care in school: An alternative approach to education*. Teachers College Press.

Ntoumanis, N., Ng, J.Y.Y., Prestwich, A., Quested, E., Hancox, J.E., Thøgersen-Ntoumani, C., Deci, E.L., Ryan, R.M., Lonsdale, C., & Williams, G.C. (2021). A meta-analysis of self-determination theory-informed intervention studies in the health domain: Effects on motivation, health behavior, physical, and psychological health. *Health Psychology Review, 15*(2), 214–244. https://doi.org/10.1080/17437199.2020.1718529

O'Connor, D.B., Thayer, J.F., & Vedhara, K. (2021). Stress and health: A review of psychobiological processes. *Annual Review of Psychology, 72*(1), 663–688. https://doi.org/10.1146/ANNUREV-PSYCH-062520-122331

Roberts, G.C., & Nerstad, C.G.L. (2020). Chapter 24: Motivation. Achievement goal theory in sport and physical activity. In D. Hackfort& R.J. Schinke (Eds.), *The Routledge international encyclopedia of sport and exercise psychology. Volume 1, theoretical and methodological concepts* (pp. 322–341). Routledge.

Roberts, G.C., Nerstad, C.G.L., Lemyre, P.N., Roberts, G.C., Nerstad, C.G.L., & Lemyre, P.N. (2018). Motivation in sport and performance. In O. Brodikk (Ed.), *Oxford research encyclopedia of psychology*. Oxford University Press. https://doi.org/10.1093/acrefore/9780190236557.013.150

Rodrigues, F., Macedo, R., Teixeira, D.S., Cid, L., Travassos, B., Neiva, H., & Monteiro, D. (2021). The co-occurrence of satisfaction and frustration of basic psychological needs and its relationship with exercisers' motivation. *Journal of Psychology: Interdisciplinary and Applied, 155*(2), 165–185. https://doi.org/10.1080/00223980.2020.1862738

Rohleder, N., Chen, E., Wolf, J.M., & Miller, G.E. (2008). The psychobiology of trait shame in young women: Extending the social self preservation theory. *Health Psychology, 27*(5), 523–532. https://doi.org/10.1037/0278-6133.27.5.523

Ryan, R.M., & Deci, E.L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68

Ryan, R.M., & Deci, E.L. (2007). Active human nature: Self-determination theory and the promotion and maintenance of sport, exercise, and health. In M. Hagger& N.L.D. Chatzisarantis (Ed.), *Intrinsic motivation and self-determination in exercise and sport*. Human Kinetics.

Ryan, R.M., & Deci, E.L. (2017). *Self-determination theory. Basic psychological needs in motivation, development, and wellness*. Guilford Press.

Ryan, R.M., Duineveld, J.J., Domenico, S.I.D., Ryan, W.S., Steward, B.A., & Bradshaw, E.L. (2022). We know this much is (meta-analytically) true: A meta-review of meta-analytic findings evaluating self-determination theory. *Psychological Bulletin, 148*(11–12), 813–842. https://doi.org/10.1037/bul0000385

Seifriz, J.J., Duda, J.L., & Chi, L. (1992). The relationship of perceived motivational climate to intrinsic motivation and beliefs about success in basketball. *Journal of Sport and Exercise Psychology, 14*(4), 375–391. https://doi.org/10.1123/jsep.14.4.375

Sjögren, E., Leanderson, P., Kristenson, M., & Ernerudh, J. (2006). Interleukin-6 levels in relation to psychosocial factors: Studies on serum, saliva, and in vitro production by blood mononuclear cells. *Brain, Behavior, and Immunity, 20*(3), 270–278. https://doi.org/10.1016/j.bbi.2005.08.001

Slavish, D.C., & Szabo, Y.Z. (2019). The effect of acute stress on salivary markers of inflammation: A systematic review and meta-analysis. *Brain, Behavior, and Immunity, 88*, 887–900. https://doi.org/10.1016/j.bbi.2020.04.078

Spruit, A., Kavussanu, M., Smit, T., & IJntema, M. (2019). The relationship between moral climate of sports and the moral behavior of young athletes: A multilevel meta-analysis. *Journal of Youth and Adolescence, 48*(2), 228–242. https://doi.org/10.1007/s10964-018-0968-5

Steptoe, A., Hamer, M., & Chida, Y. (2007). The effects of acute psychological stress on circulating inflammatory factors in humans: A review and meta-analysis. *Brain, Behavior, and Immunity, 21*(7), 901–912. https://doi.org/10.1016/j.bbi.2007.03.011

Szabo, Y.Z., & Slavish, D.C. (2021). Measuring salivary markers of inflammation in health research: A review of methodological considerations and best practices. *Psychoneuroendocrinology, 124,* 105069. https://doi.org/10.1016/j.psyneuen.2020.105069

Thomsson, O., Ström-Holst, B., Sjunnesson, Y., & Bergqvist, A.S. (2014). Validation of an enzyme-linked immunosorbent assay developed for measuring cortisol concentration in human saliva and serum for its applicability to analyze cortisol in pig saliva. *Acta Veterinaria Scandinavica, 56*(1), Article 55. https://doi.org/10.1186/s13028-014-0055-1

Tibana, R.A., De Almeida, L.M., Frade De Sousa, N.M., Nascimento, D.D.C., Neto, I.V., De Almeida, J.A., De Souza, V.C., Lopes, M.D., Nobrega, O.D., Vieira, D.C., Navalta, J.W., & Prestes, J. (2016). Two consecutive days of extreme conditioning program training affects pro and anti-inflammatory cytokines and osteoprotegerin without impairments in muscle power. *Frontiers in Physiology, 7,* Article 260. https://doi.org/10.3389/fphys.2016.00260

Uchino, B.N. (2006). Social support and health: A review of physiological processes potentially underlying links to disease outcomes. *Journal of Behavioral Medicine, 29*(4), 377–387.

Vasconcellos, D., Parker, P.D., Hilland, T., Cinelli, R., Owen, K.B., Kapsal, N., Lee, J., Antczak, D., Ntoumanis, N., Ryan, R.M., & Lonsdale, C. (2020). Self-determination theory applied to physical education: A systematic review and meta-analysis. *Journal of Educational Psychology, 112*(7), 1444–1469. https://doi.org/10.1037/edu0000420

Watson, D., Clark, L.A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*(6), 1063–1070. https://doi.org/10.1037/0022-3514.54.6.1063

Wise, K., Kenney, E, & Hogue, C.M. (2022). *A qualitative investigation into the impact of the perceived motivational climate on male college students' motivations and experiences while learning a new physical activity-based skill*. Association for Applied Sport Psychology Annual Conference, Fort Worth, TX.