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Ultra-Running, the Upcoming Sport of the Endurance World: Is Emotional Intelligence associated with performance?

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Abstract

The present study's overall aim was to add to the scarce literature regarding the sport of ultra-running and factors that improve athletic performance. Moreover, I sought to provide support for the use of the tripartite theory of Emotional Intelligence (EI) when considering athletic performance. The specific aim of the study was to determine how much tripartite-EI adds to the prediction of ultra-runners 100km personal best after confounding performance variables have been controlled for. Additionally, I was interested if there are any mediating variables affecting the relationship between tripartite-EI and 100km personal best. Participants were recruited online through various social media platforms and ultra-running events. They completed an online questionnaire containing a list of demographics, running related questions and three psychometric measures to assess each level of Tripartite EI; Trait Emotional Intelligence Questionnaire Short Form, Situational Test of Emotion Understanding- Brief, and Situational Test of Emotion Management-Brief. Structural Equation Modeling was performed to examine the interrelations among the variables and revealed that Tripartite EI's influence on ultra-runners 100km personal best is entirely mediated by an athlete's training load. Potential explanations for the mediating effect are discussed within the context of EI related factors (i.e., self-control, self-motivation) that could theoretically enhance an athlete's training.

Keywords: *Emotional Intelligence, Endurance Sport, Running, Ultra-running*

Introduction

Ultra-marathon running is a sport with an enormous, recent surge in popularity. From 1996 to 2018, the number of participants has gone from 34,401 to 611,098, with the past ten years containing the largest spike (137,234 to 611,098) (Ronto & Nikolova, 2020). Even with this increase in popularity, ultra-running is still unknown to the majority of North Americans.

An ultra-marathon is an endurance event where competitors run any distance greater than the standard marathon distance of 42.2 kilometers (km). The events can vary in size and structure, with some common events being; 24/12/6 hour races where the goal is to achieve the greatest distance within the specified time, 50km/100km/160km races where the goal is to complete the specified distance as fast as possible, and multi-stage events where runners complete distances upwards of 300km over multiple days, or see how much distance they can achieve over multiple days. There is also a wide variety of courses for these races, each presenting unique challenges for the competitors. For example, some races take place on a standard 400m track, some on longer closed-loops, some can be point to point. The surface can be rubber, dirt, trail, road, or a mix of all of them (Olbrich, 2012).

Throughout these competitions, athletes face a wide range of physiological and psychological stressors that can impact performance. These include, but are not limited to; pain, discomfort, high injury rates, gastrointestinal distress, mental and physical exhaustion, uncertainty, boredom, mood fluctuations, and environmental changes (Ven gent et al., 2007; Hinze, 2012; Gobel, 2012; Simpson et al., 2014; Samson et al., 2017; Critchley, 2019; Graham et al., 2020; Burgum & Smith, 2020). Runners also report experiencing positive effects and emotions throughout ultra races as well. Mainly runners report experiencing feelings of euphoria and/or confidence associated with overcoming ultra related challenges, feelings of inclusivity/belonging associated with the strong community surrounding ultra events, a sense of self-discovery, spirituality, and pioneering of a new sport (Simpson et al., 2014; Samson et al., 2017; Critchley, 2019).

The inevitable challenge of endurance events is to continue going at your maximum potential even when it starts to hurt, and your mind wants you to quit. This undeniable reality of endurance competitions, especially prevalent in ultra-marathon running, reveals the potential impact that emotional intelligence (EI) may have on ultra-running performance, as runners have to regulate intense emotions associated with many of the stressors and challenges, they face throughout a race. This pilot study explored the nature of the relationship between EI and ultra-running performance at the 100km distance. In the paragraphs to come, we will examine the existing literature regarding EI, as well as its role within endurance spot.

Overview of EI Theory

EI is defined as "individual responses to intrapersonal or interpersonal emotional information and encompasses the identification, expression, understanding, regulation, and use of emotions" (Laborde et al., 2018, p. 290). Since EI's introduction in the late '80s/early '90s, there have been a few predominant models to conceptualize and study EI's construct. First, is the trait perspective of EI, which classifies EI into a cluster of lower-order personality traits such as adaptability, assertiveness, impulsiveness, stress management, etc. (Petrides et al., 2007). Second, is the ability perspective of EI, which views EI as a cognitive ability and breaks EI down into a four-factor model that includes: the ability to perceive emotions in self and others, assimilation of emotional information into cognitive processes, the ability to understand emotions and their causes/relationships/consequences, and the ability to effectively regulate emotions (Mayer et al. 2000; Mayer et al., 2004). In the past decade, a new EI model, put forth by Mikolajczak (2009), has been gaining in popularity. This model attempts to reconcile the ability and trait perspective into one coherent model. This model has been labelled the tripartite model of EI, which breaks EI into three factors; knowledge, ability, and trait. EI-knowledge can be explicit or implicit, and it represents what we know about our emotions, the emotions of others, and how to handle emotional situations (i.e., emotional regulation strategies). EI-ability represents our skill at implementing our emotional regulation strategies. Lastly, EI-trait represents our habitual ways of responding to emotional stimuli. These three levels are organized in a hierarchy where knowledge underlies ability which underlies trait, subsequently working together to influence our responses to emotional information. The present study will be based on this tripartite-EI model.

EI and athletic performance

The need for a more coherent tripartite-EI model is highlighted by a meta-analysis done by Kopp and Jekauc (2018) which looked at 22 studies done between 2001 and 2018 that studied the relationship between EI and competitive sports performance. Their analysis found a small but significant positive relationship between higher levels of EI scores and better performance. In the majority of studies included in the analysis, EI was also most often conceptualized as a trait, but type of conceptualization – ability or trait - was not a significant moderator of the relationship between EI and athletic performance. This was an interesting result as it was expected that different conceptualizations would produce different results or that research would support the use of one conceptualization over the others. They attribute this result to lack of theoretical discourse regarding the model of EI selected, or the selected model was not reflected in the measurement choice, within the studies included in their meta-analysis. More research is needed to determine the superiority of one model over another.

The above result from Kopp and Jekauc (2018) highlights a significant problem, there is a lack of clarity when discussing and measuring EI within the research community and the overlap among models only exacerbates this problem. This lack of clarity has resulted in researchers primarily measuring EI on the trait level, while ignoring the clear impact EI knowledge and ability may have on sporting performance. One possible reason for the existing research's lopsided nature could be that the research into EI and athletic performance is still relatively new, and because the relative ease of measuring trait-EI, so it is often the preferred choice for inclusion in studies even if that is not the conceptualization of EI they wish to use. Despite the lack of clarity and lopsided nature, the initial research into trait-EI and athletic performance with a specific focus on endurance sports, has been relatively successful in demonstrating that trait-EI is beneficial for performance outcomes for athletes.

Trait-EI and Endurance Performance

Using a structural equation model, Rubaltelli et al. (2018) determined that trait-EI – measured using the Trait Emotional Intelligence questionnaire short-form was the strongest predictor of half marathon time, even above training load. An athlete’s training load was defined as the number of training sessions and number of kilometers run per week. This is an intriguing result, as one would expect training load to be the strongest predictor of success.

A study conducted by Howe et al., (2019) helps explain the relation between trait-EI and running time. Howe et al. looked at how trait-EI impacts runners' mood states and stress response during a treadmill ultra-marathon. The use of a treadmill in this study was unique because it allowed researchers to assess mood at three different points and consistently take blood serum cortisol measurements. There were three significant results from this study; first, runners high in trait-EI experienced less severe mood fluctuations throughout the event than those with lower trait-EI scores. Second, opposite to what they expected, blood serum cortisol increased more in the high trait-EI group than the low trait, indicating greater physiological stress. Lastly, runners in the high trait-EI group reported a lower rate of perceived exertion (RPE) compared to the low EI group in response to similar intensities. Taken together, the second and third results from Howe et al. (2019) indicate that runners low in EI are under greater psychological stress than physiological stress. These results demonstrate that trait-EI could be a more significant performance variable at the sub-elite level than training. Theoretically, under the psychobiological model of fatigue where RPE is one of the main determinants of endurance performance (McCormick et al., 2019), an athlete would become overwhelmed psychologically before reaching their maximum physiological potential in competition and training. Thus, runners low in EI may not be performing to their full potential in training and competition because they cannot "push hard enough" due to lacking the meta-cognitive strategies required for effective emotion regulation compared to those with high EI.

Similar to Howe et al., (2019), Lane and Wilson (2011) found significant changes in mood throughout a six-day ultra event, but the experienced emotions of runners depended on their level of trait-EI. Runners higher in trait-EI experienced less anger and confusion while reporting increased happiness, calmness, and decreased tension and fatigue. These results support the idea that runners high in EI are better at regulating their emotions to match their ideal emotional state for maximum performance, which was characterized by increased feelings of happiness and calmness, more energized, less anxious, sluggish and downhearted (Lane et al., 2016).

If EI was solely a trait, you would expect this trend of more pleasant emotions to persist following the completion of an ultra-marathon; however, this is not the case. Nicolas et al. (2019) demonstrated that anger increased linearly in the months following a mountain ultra-marathon. For those high in EI, there was a negative association with happiness and excitement. Taken together, these results suggest that ultra-runners may exhaust their ability to regulate their emotions after an ultra-marathon. This suggests that EI is, to some degree, a cognitive ability that can become harder to access after excessive use. Self-control is a critical part of effective emotion regulation, and the strength model of self-control states that self-control is a resource that can be depleted (Reeve, 2015a; Stocker et al., 2020), which could explain why athletes normally high in EI are unable to regulate their emotions after a race effectively. The results presented above demonstrate the importance of EI for ultra-endurance athletes, but they also cast doubt on its conceptualization solely as a trait. To some degree, it is clear that an athlete's ability to engage in the emotion regulation process actively and their knowledge of how to do so are crucial.

Emotional Regulation Strategy: Use and Endurance Sport Performance

> "I went through the 2k and the 4k on the back of the leading group. Ah, and going into the third lap, I started falling off the leading group. And that…it was everything for me to stay attached, and it was only for there was a person there standing at that time, and suddenly I just lost a seconds concentration, and it was like, 'don't lose the concentration, concentrate now', and I covered the move, and…I finished second…in that race. But only for that split second, it meant everything for me. It was like down to, I'd say literally, two seconds worth of concentration like, 'cause if I had fallen off that group, I wouldn't have gotten back on the group, and that would have been it..."

The above passage from one of the elite runners that participated in Brick et al. (2015, p. 14) study on cognitive control use in elite endurance runners highlights how the difference between a podium finish or a middle of the pack finish can come down to a split-second decision made on the athletes part about whether to apply an associative or dissociative metacognitive strategy. Metacognition can be broken down into the regulation of cognition through active strategy use, and metacognitive experience, which involves the feeling of knowing when to apply a strategy, according to the level of difficulty of the task or situation and the individual's confidence in their strategy selection (Tarricone, 2011; Brick et al., 2015). The use of metacognitive strategies is a critical part of the emotion regulation process. These strategies can be broken down into two broad categories within the sport context: associative strategies and dissociative strategies. Associative strategies can be seen as actively focusing on a particular aspect of performance to overcome performance-related challenges and stressors. Dissociative strategies can be seen as actively distracting yourself from these challenges and their associated stressors to overcome them (Silva & Appelbaum, 1989). Effective strategy use is essential for optimal performance, and it appears that associative strategies are most useful for more intense running while dissociative strategies are more useful for slower, easier running; although the right balance has to be achieved and some strategies can fall under both categories depending on their use (Silva & Appelbaum, 1989; Masters & Ogles, 1998; Brick et al., 2015; Cona et al., 2015).

The most common associative strategies used by endurance runners at the ultra and sub-ultra levels are setting performance-related goals (Reeve, 2015b; Lane, 2019) and preparing a proper race strategy according to the course (Simpson et al., 2014). Faster runners can then use these performance goals as feedback during competition and are better at ignoring irrelevant or distracting information such as pain or an upcoming hill. This increases their chance of goal attainment and receiving a corresponding boost of positive emotions (Lane, 2019; Cona et al., 2015). In addition to setting larger goals, athletes can also set micro-goals (i.e., focus on getting through the next 1km) within the race to help keep them focused on executing proper form when they begin to feel overwhelmed; this strategy is known as "chunking" distances (Brick et al., 2015; Samson, 2017). Failure to meet a goal can lead to goal frustration and a wave of associated negative emotions, but more successful endurance athletes possess superior cognitive reappraisal skills compared to their less successful counterparts (Giles et al., 2018; Roebuck et al., 2020). Superior cognitive reappraisal skills allow the athlete to re-evaluate what goal frustration means – for example, is it because I am not working hard enough? Or am I physically incapable of achieving that? – and adapt their goals and race strategy as necessary.

In addition to having performance-related goals, other common metacognitive strategies that are used by ultra-runners to help regulate their emotions in the race are imagery, positive self-talk, acceptance, and maintaining proper breathing during difficult stretches (Torves, 2010; Simpson et al., 2014; Samson et al., 2017; McCormick et al., 2019). Simpson et al. (2014) and Samson et al. (2017) took an in-depth look at the in-race mental experiences of ultra and distance runners using qualitative interviews and the 'think aloud thought recording' protocol. Both studies identified the in-race presence of a number of the strategies discussed above. Taken together, these studies demonstrated that ultra-runners rely on a wide variety of strategies, some associative and some dissociative, to help them regulate their emotions in order to overcome the challenges they face throughout a race. This is not surprising considering that associative strategies are more useful for higher intensity running while dissociative strategies are more useful for slower, easier running; ultra-marathons often involve combining the two.

Additionally, the sheer length of the competitions and the wide variety of stressors that runners can face make it even less surprising that ultra-runners must possess a wide variety of psychological skills to be successful. Thus, this evidence supports the notion that the ultra-endurance athlete plays an active role in regulating emotions. This, in turn, supports the idea that EI is an ability that is influenced by an athlete's knowledge of when and where to implement certain strategies.

The Present Study

When considering the current evidence demonstrating the importance of trait-EI in endurance sport and the wide variety of metacognitive strategies that endurance athletes use, it becomes clear that an athlete's EI ability and knowledge are important performance variables in addition to their trait-EI. The sport of ultra-running is rapidly growing in popularity but has received little attention in academic and scientific literature, and too often, EI has been conceptualized solely as a trait. Thus, the present study's overall aim is to add to the scarce literature by utilizing the emerging tripartite theory of EI within the endurance sport context, specifically, ultra-marathon running. The specific aim of this exploratory study is to examine how much tripartite-EI adds to the prediction of 100km personal best (PB) after confounding performance variables have been controlled for, and if there are any mediating variables affecting the relationship between tripartite-EI and 100km PB. This study used structural equation modeling to explore the interrelations between the performance variables, tripartite-EI and 100km PB. This research can potentially help with elucidating the factors of EI that are most important for ultra-runners; which could help guide future research examining ways to use EI as a means of enhancing ultra-running performance.

Methods

Sample and Procedures

Final sample contained 288 participants. Recruitment was conducted online through events on raceroster.com and social media platforms including Facebook, Reddit, and Strava. Participants completed a Qualtrics questionnaire that was made accessible through social media posts or e-mails from race directors, both containing a brief description of the study. $50 Amazon gift card was rewarded as incentive to participate. The study received ethics approval from Trent Universities’ Research Ethics board.

Measures

The questionnaire contained sections addressing demographics, Ultra-Running experience, training, race strategy, and the 3 separate components of Tripartite-EI. The demographic section addressed participant age and sex. The ultra-running experience section asked questions to gather data regarding the number of past races, preferred racing distance, their PB at the 100k distance, and details about the course they ran on (i.e., surface/terrain and elevation gain). Training and race preparation/strategy questions assessed weekly training habits, that is, from 0 to 8 how many training sessions per week, average weekly km and, level of detail in their race plan/strategy, where 0 = no plan for overall time, splits, nutrition, gear, and course research and 5 = detailed plan for overall time, splits, nutrition, gear, and course research. The Trait Emotional Intelligence Questionnaire –

Short Form (TEIQue-SF)(Petrides, 2009) was used to measure the Trait level of tripartite-EI. This 30 item self-report test was rated on a 7-point likert scale and provides a global Trait-EI score. The Situational Test of Emotion Management – Brief (STEM-B) (Allen et al., 2014) was used to measure the ability level of tripartite-EI. This 18 item self-report test required participants to select the most appropriate action for managing an emotion eliciting situation. The Situational Tests of Emotion Understanding-Brief (STEU-B) (Allen et al., 2014) was used to measure the knowledge level of tripartite-EI. This 19 item self-report test required participants to select the emotion they would most likely feel in response to a emotion eliciting situation.

Creation of Tripartite-EI and Missing Data

In order to deal with the incomplete data on my three psychometric measures (TEIQue-SF, STEU-B and STEM-B) the following data management actions were taken. First, when creating the TEIQue-SF total variable, missing data was replaced using Multiple Imputation (MI), a highly recommended statistical technique designed to handle missing data by generating random values based off the observed data (for a more in depth review of MI see Manly & Wells, 2014; Murray, 2018). However, participants who had an incompletion rate of greater than 15% on the TEIQue-SF-SF were coded as “missing”. This decision was made because when imputing data using MI it has been demonstrated that MI can handle up to 90% missing data if there are enough complete entries (Madley-Dowd et al., 2019). However Jakobsen et al., (2017) recommends that if there is greater than 40% missing data only the observed data should be used. Lastly, Enders (2003) reports that missing data of 15 to 20% are common in psychological studies. Based on the above recommendations I chose 15% because this cut-off achieved my target sample size and did not threaten the integrity of the data for analysis. Lastly, I felt MI was appropriate for the TEIQue-SF because it was scored on a continuous likert scale ranging from 1 to 7. Each answer is rewarded a point regardless of degree of correctness, thus the overall totals should not be greatly affected by replacing missing values using MI.

Regarding the creation of the STEU-B and STEM-B total variables only the observed data was used. Any participant who failed to answer a question was assigned “missing” for the STEU-B total and STEM-B total respectively. This decision was made due to the format of scoring for each measure. Correct answers received points and incorrect answers did not. It follows that MI would threaten the integrity of the data because assigning people points may artificially inflate the total scores for the STEU-B and STEM-B respectively, thus I felt it was safer to score them as missing. Specifically regarding the STEM-B I also elected to only use the observed data because the correct answers were scored as fractions when more than one was available. Thus using MI runs the risk of the computer imputing “impossible fractions”, meaning scores that are impossible to obtain. The risk of “impossible fractions” threatens the integrity of the data further. Lastly, because most participants either completed the whole STEM-B measure or none of it MI would only result in another 2 participants for this measure.

It is also worth noting that both the STEU-B and STEM-B suffered from reliability issues. According to Allen et al., (2014) the Chronbach’s alpha of the STEU-B should reach .63 and .84 for the STEM-B. However, for the STEU-B I obtained a Chronbach’s alpha of .49 well below the expected .63. Regarding the STEM-B I obtained a Chronbach’s alpha of .62, again well below the expected .84. In addition to not meeting the expected level of reliability, the obtained Chronbachs alphas of .49 for the

STEU-B and .62 are low enough to cause worry. This is because according to Gliem and Gliem (2003) Chronbach's alpha values ranging from .50 to .60 have questionable reliability and those ranging from .60 to .70 have poor reliability. Despite these reliability issues I elected to keep these variables due to the exploratory nature of the study as well as their theoretical and practical importance in the model. The TEIQue-SF had no reliability issues registering a Chronbach's alpha of .88.

Lastly, in order to assess the combined effect of each facet of EI on 100 km PB I created a "Tripartite-EI" latent variable. The TRI.EI latent variable was created by modeling participants STEU-B, STEM-B, and TEIQue-SF total scores. This TRI.EI model was then used as a direct and indirect predictor of 100km PB in my overall model.

Results

Descriptive Statistics

My final sample had a total of 288 participants, 68% of the sample was male (SEX, n = 287) with a mean age (AGE) of 39.73 (SD = 10.54). The average time for the outcome variable of runners 100km PB (PB100K) was 14:42:21 with quite a large standard deviation (SD = 3:33:06) indicating a wide distribution of final times. The average elevation on runners 100km PB in meters (PB.ELEV) was very high but was also distributed very widely. This makes sense considering 73% of the sample completed their 100km PB on a trail run (PB.SURFACE, n =288).Overall runners in the sample had moderate to high levels of emotional intelligence across the 3 observed EI variables (STEU-B, STEM-B, TEIQue-SF) constituting the latent variable TRI.EI. The number of training sessions per week (AVG.SESSION) runners averaged was moderate to high. In a similar fashion, runners average kilometers per week (AVG.KM) were also moderate to high but had a wider distribution. Lastly, regarding the level of strategy preparation (RACE.PLAN) the runners in my sample reported a moderate level of strategy preparation with a mean of 3.04, (SD =1.14) (See Table 1 in the Appendix).

SEM Analysis

A SEM analysis was performed using the software Rstudio and the 'lavaan' package, to determine the effects of Tripartite-EI on 100km PB and if there are any mediating variables affecting this relationship.

The model fit was estimated using the comparative fit index (CFI), the Tucker-Lewis Index (TLI), and the root mean square error approximation (RMSEA). For a good fit the CFI and TLI should both be $\geq .95$, and the RSMEA should be $\leq .06$ (Kumar & Upadhaya, 2017). When I attempted to fit the latent variable model including all three suspected mediating variables (RACE.PLAN, AVG.SESSION, AVG.KM) the models would not converge. It was suspected that including multiple mediating variables was creating noise that was interfering with model fit. Especially considering AVG.SESSION and AVG.KM were essentially measuring the same construct and were not orthogonal (r = .48, p <.001). It follows that the strongest predictor of PB100K would be kept which was AVG.KM (r = -.39, p <.001), RACE.PLAN was dropped because it failed to reach significance (r = -.09, p = .12). The updated model fit the data well CFI = 1.00, TLI = 1.00, RSMEA = < .001, supporting the notion that the extra mediating variables were creating noise interfering with the model fit.

Regarding the cofounding performance variables my analysis revealed PB.SURFACE had a negative relationship with PB100K (β = -.17, p = .03), indicating that runners who completed their PB100K on the trail finished slower than on other surfaces. Additionally, PB.ELEV had positive relationship with PB100K (β = .22 p = .01) indicating that runners with more elevation on their course finished slower. Both the significant relationships were in the expected direction. Lastly, AGE (p =.67) and SEX (p =.32) failed to reach significance. Regarding the hypothesized relationships my analysis failed to fully support their existence. AVG.KM did significantly predict PB100K (β = -.34, p <.001) as expected, however the latent TRI.EI variable failed to directly predict PB100K (p = .26) or AVG.KM (p = .19) resulting in a non-significant indirect path through AVG.KM to PB100K as well (β = -.07, p = .21). Despite falling to observe the indirect path from the latent TRI.EI variable through AVG.KM to PB100K the relationship was trending in the right direction and of similar magnitude as the other significant effects, which is promising and will be discussed next (See Figure 1 in the Appendix).

Discussion

The present study sought to elucidate how Tripartite-EI adds to the prediction of ultra-runners 100km PBs after confounding performance variables have been controlled for. Additionally, I was interested in mediating effects between Tripartite-EI and runners 100km PBs. My analysis revealed that after controlling for confounding performance variables, the amount of kilometers run per week was the strongest predictor of an athlete's 100km PB. The direct and indirect path from tripartite-EI to 100km PB failed to reach significance. However, the indirect relationship was trending in the right direction and of similar magnitude as the other significant effects. While this result is not conclusive, it is promising given the exploratory nature of the study and when considered together with previous research. Rubaltelli et al. (2018) demonstrated that EI directly impacts runners finishing times in half marathons, more so than training load. They speculated that at longer race distances training could become a more important variable as the physiological demands are greater, resulting in a shift to a indirect effect of EI on performance. This notion seems to support the conjecture that the hypothesized indirect path does exist to some degree due to the physiological stress inherent to running a ultra-marathon. Following this line of reasoning it seems fair to assume that an athlete's performance at the ultra-endurance level is impacted by EI indirectly though kilometers run by enhancing an athletes' ability to sustain a larger training volume leading up to their event.

When further examining the evidence related to the above conjecture we can see there are many psychological and physiological outcomes related to higher EI that could theoretically help athletes throughout training. Individuals who display high levels of EI often have superior self-control and reappraisal skills, higher levels of self-motivation and optimism, experience more positive emotions and less physiological stress, they demonstrate greater ability to understand and manage their emotions, they are more flexible, resilient, and posses superior problem solving skills (Fernández-Berrocal, & Extremera, 2006; Meyers & Fletcher, 2007; Lane & Wilson, 2011; Kumari, 2016; Roebuck et al.,2020).

Following a proper training plan for an ultra-marathon is no easy task, it consumes a large amount of energy, is a large time commitment, and provides constant emotion eliciting challenges to overcome such as injures, scheduling related time constraints, goal conflict, lack of motivation, and mental/physical fatigue (Olbrich, 2012; Simpson et al., 2014; Samson et al., 2017). Individuals with higher levels of EI display greater self-control abilities and have higher levels of self-motivation. The constructs of self-control and self-motivation are essential for effective goal pursuit/attainment because they aid us in directing our behaviour toward a desired outcome (Reeve, 2015; McCormick et al., 2019). In the case of an athlete training for an ultra-marathon they would have either a time goal or a distance goal in mind and a training schedule to help achieve this goal. The athlete in question must be able to motivate themselves to inhibit undesired responses and instead engage in the desired responses that will help achieve their goal. Theoretically speaking, an athlete with higher levels of EI would be more effective at motivating and directing their behaviour throughout their training-- which would then lead to a larger training load and better performance come race time. Interestingly, self-motivated individuals tend to be more optimistic (Rygula et al., 2015), a quality that has been linked to higher levels of EI (Kumari, 2016). Thus it could be that individuals with higher levels of EI have an easier time motivating themselves to train due to their optimistic nature.

Additionally, training for an ultra-marathon is going to bring up many negative emotions, whether the source of these emotions is injury, goal conflict, fatigue or any other training related stressor, athletes need to manage these emotional reactions effectively if they are going to continue training at an optimal level. Individuals with higher levels of EI tend to have a better understanding of their emotions, experience more positive emotions and are better at managing them. Specifically, ultra-runners seem to have superior positive reappraisal skills. Within a training context an athlete's ability to make use of positive reappraisal becomes extremely important when dealing with setbacks. Consider an athlete, who injures their calf, they make the primary appraisal that they are injured and therefore cannot train leading to frustration at their inability to train and lost fitness. While this may be true the athlete can also reappraise the event in a positive light, that is, I may not be able to run but I can still cycle – this reappraisal of the event (injury) allows the athlete to adopt a more positive attitude toward their current situation and still progress toward their goal along an alternative path. Thus, athletes who posses higher levels of EI could theoretically manage the negative emotions associated with training setbacks better compared to their lower EI counterparts. Superior positive reappraisal skills would result in the experience of more positive emotions. This would then feed back into the athletes' motivation to train more, resulting in a larger training load and better performance.

The various challenges associated with ultra-marathon training listed above all create problems that elicit a stress response. The magnitude of this stress response can vary and one factor that influences the magnitude of an individual's stress response is their level of EI. It seems to be that individuals who possess high levels of EI display reduced physiological and psychological responses to stress. This is demonstrated on self-reports of perceived stress, as well as higher Heart Rate Variability and lower cortisol levels, two biological markers of stress (Fernández-Berrocal, & Extremera, 2006; Laborde et al., 2016). EI related factors that help to mitigate stress include resiliency, greater flexibility in emotions and superior problem solving skills (Meyers & Fletcher, 2007; Kumari, 2016; Laborde et al., 2016). Within the context of ultra-marathon training, flexibility in emotions would mitigate stress because it would assist the athlete in shifting their mood. This would be useful when making reappraisals such as the response to injury described in the previous paragraph, or when attempting to self-motivate to engage in the proper goal oriented behaviour. Problem solving skills mitigate stress because they enable the athlete to come up with alternative solutions to the challenges they face such as; cross training methods in response to injuries, restructuring training when scheduling conflicts arise, meal planning, use of different coping methods, etc. Lastly, resiliency would help to mitigate stress because athletes with higher levels of resiliency would be able to rebound emotionally faster following any training setbacks, allowing them to deal with them faster and more effectively. Therefore, athletes with high levels of EI are better equipped to deal with the stress that is associated with ultra-marathon training. This in turn allows them to maintain a larger training load, which results in a better performance.

In conclusion, despite failing to reach significance the results were trending in the right direction which is promising especially when considered in conjunction with past research. Discussed above was the hypothesized shift from a direct to indirect path, which is most likely due to the increased physiological demands of longer races. Next, factors related to high levels of EI that could potentially contribute to maintaining an increased training load were examined and centered on the following topics. First, I discussed the relationship among self-control, self-motivation, optimism and how they related to goal pursuit. Second, I explored the ability to understand and manage emotions, specifically the use of positive reappraisal and how it results in the experience of more positive emotions. Finally, I considered how EI mitigates the stress response and the implications of this when training for an ultra-marathon.

Limitations and Future Directions

Despite being theoretically sound and fitting the data well the hypothesized relationships failed to reach significance. This is most likely due to the weaker measures (STEU-B and STEM-B) which struggled to measure the knowledge and ability components of TRI.EI reliably. This would have caused measurement error which when present, even in small amounts, can render a valid model invalid (Cole & Preacher, 2014). It was extremely difficult to find a suitable measure to assess tripartite-EI generally and within a sporting context. The STEM-B and STEU-B were not ideal for my study but rather selected due to financial and time constraints, as well as ease of implementation within my study design. Thus, while they allowed me to undertake this exploratory study, future research on Tripartite-EI could benefit greatly from a questionnaire designed to directly assess this construct, particularly for those involved in sports and/or other physically demanding activities.

Further to this, the choice of runners 100km PB as the measure of athletic performance was influenced heavily by the COVID-19 pandemic restrictions. This measure was not an ideal outcome to assess running performance, especially at such extreme distances, as there was a large amount of variance in finishing time to be explained. This was mostly because using 100km PB as the outcome variable resulted in a substantial amount of course variation that would impact finishing times. In order to account for course variance in an ideal manner, runners would have been recruited at an event where they all ran on the same course which would account for any of these course related variables (i.e., type, terrain, weather, etc.) that impacted their finishing times. However, due to COVID-19 restrictions I was unable to execute the study in-person. As a result I had to attempt to account for course related variables as best I could statistically which could have further changed the outcome of the results due to inaccurate self-reporting and large variation in course features. Additionally, I had large amounts of missing data resulting, most likely, due to response fatigue as the majority of it came toward the end of the questionnaire, which resulted in smaller n's for the EI related variables. Together these limitations may explain why no direct and/or indirect effect between tripartite-EI and 100km PB was detected. Due to the limitations discussed above and the promising nature of the observed relationships it may be worth conducting a similar version of this study in person at a live ultra-running event to control for any course related variables and ensure a more complete data set for accurate analysis. If these adjustments are made it would be interesting to see if a direct and/or indirect effect of Tripartite-EI on ultra-running performance is revealed.

Conclusion

This exploratory study sought to provide support for the use of the Tripartite-EI model within a sporting context, by exploring its relationship to athletes 100k PB's. Combine with previous research the present results provide preliminarily evidence supporting the notion that at longer distances EI does not directly impact performance; rather it exerts its effects by enhancing an athlete's training, although future research is needed to confirm this. Possible explanations for how EI may enhance an athlete's training were discussed and centered on the following EI related factors: self-motivation, self-control, optimism, emotional knowledge, emotional regulation ability, positive reappraisal, and reduced stress response. Finally, I considered the limitations of the present study which focused on unreliable measures, and various measurement problems associated with the outcome variable PB100K. Future research may consider replicating this study with the outlined adjustments and/or examine the relationships between the EI factors theorized to enhance an athlete's training to better understand how EI impacts an athlete's training.

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Table 1. *Means, Standard Deviations, Range, Sample Size of continuous variables entered in the model.*

Variable	Mean	SD	Min	Max	N
AGE	39.73	10.54	18	87	286
AVG.KM	74.44	25.05	5	160	281
PB.ELEV	2680.60	6.35	0	13000.00	264
PB100K	14:42:21	3:33:06	6:30:00	25:15:00	288
TEIQUE-SF	5.13	0.69	2.97	7	215
STEU-B	12.66	2.46	6	18	212
STEM-B	11.42	1.84	4.67	15.10	162

Note. *AGE = participant age in years; AVG.KM = the average amount of weekly km run; PB.ELEV = Amount of elevation gain on personal best, in meters; PB100K = personal best time for completing 100km distance; TEIQue-SF = Trait emotional intelligence; STEU-B = situational test of emotions understanding brief; STEM-B = situational test of emotions management brief.*

Figure 1. *Standardized results from SEM analysis*

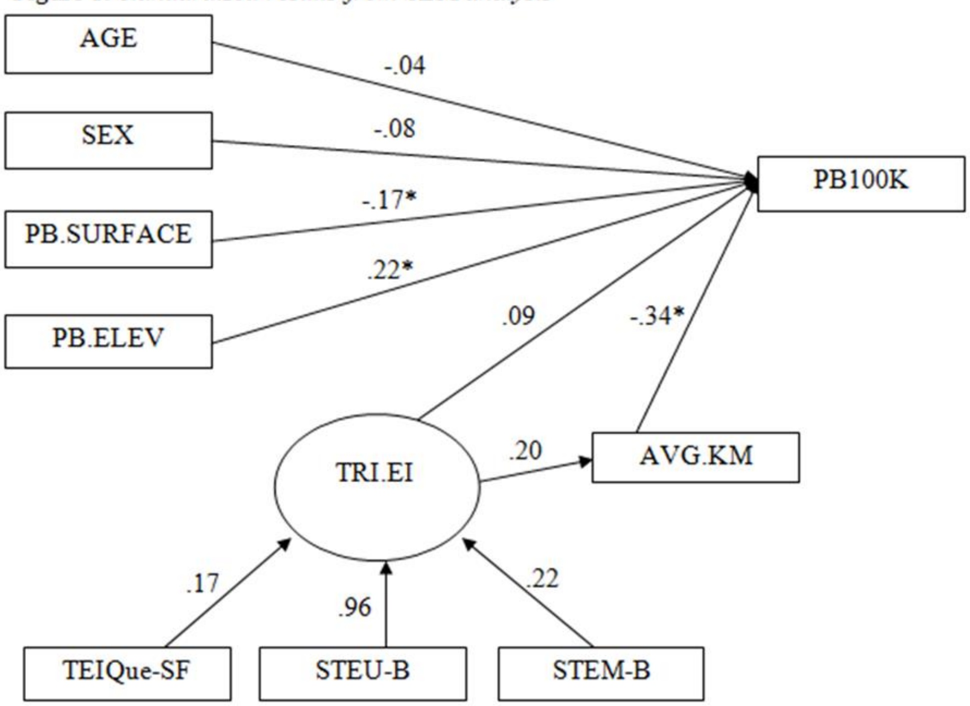

Figure 1. *Final model showing the direct effects of each performance variable on PB100K, as well as the latent variable TRI.EI with its direct and indirect paths.*
$^{*}p < .05$