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The Effect of Ironman Taper on Mood and Engagement of Nonprofessional Triathletes: An Interrupted Time Series Study

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An Ironman triathlon, which consists of swimming 2.4 miles, biking 112 miles, and running 26.2 miles, requires extensive training with planned recovery to prevent overtraining. Prior to a race, athletes commonly take a period of time for reduced training, known as a taper. Although much is known about the physical benefits of a taper, little is known about the psychological changes that occur in athletes during taper. This study assessed the mood and athletic engagement (AE) of triathletes during Ironman training, tapering, and post-race, with specific attention paid to these variables during taper. Nineteen participants, who were training for one of three selected late-season Ironman races, were recruited for the study. Data were analyzed for eight participants (five males and three females, M_{age} = 46 ± 12 years) who provided data for all time points: training, taper, and post-race. Mood subscales of the Brunel Mood Scale (Terry et al., 1999) and an overall mood scale, as well as the Athlete Engagement Questionnaire (Lonsdale et al., 2007), assessed weekly mood and engagement, respectively. Data were analyzed using time series regression analysis. Results showed no overall trends in change of mood and engagement across the three time points. However, there were significant changes in several variables on an individual level during the taper and post-race period. These individual changes demonstrate that psychological reaction to taper is a personal experience, and factors such as goal orientation, goal satisfaction, social support, competence, and coping strategies can impact the training, tapering, and post-race experience.

Keywords: triathlon, motivation, BRUMS, AEQ, self-determination

For endurance athletes to meet the physical demands of competing and training for an event, as well as prevent overtraining, proper rest and recovery must be strategically incorporated into a training cycle (Mølmen et al., 2019). One period of rest, called a taper, occurs days or weeks prior to an event. Taper refers to a reduction in training load prior to an endurance event, designed to allow the body to rest and recover in order to minimize accumulated fatigue and maximize performance (Grivas, 2018). Tapering can improve a variety of physiological parameters, such as increased red blood cell count, improved VO2, increased single muscle fiber size, and enhanced endurance performance (Bosquet et al., 2007; Mujika et al., 2004; Zehsaz et al., 2011).

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In addition to physiological adaptations, training load and tapering have been found to impact athletes' psychological state (Mujika et al., 2004). Several studies have analyzed mood fluctuations during training and tapering, although this measure is rarely the sole focus of the study (e.g., Myers et al., 2017; Zehsaz et al., 2011). Moods are transient, fluctuating affective states that reflect how an individual feels, in general, at a particular moment in time (McNair et al., 1992). Moods differ from emotions in that they tend to be less intense and are not elicited by a particular stimulus or event (Hutchinson & Jones, 2020).

Mood profile clusters have been examined in the sport and exercise domains, and the typical profile reported among athletes combines high vigor with low tension, depression, anger, fatigue, and confusion scores (Morgan, 1980; Terry, 1995). Conversely, below-average scores for vigor and above-average scores for tension, depression, anger, fatigue, and confusion represent total mood disturbance (TMD), and this profile is associated with overtraining and decreased athletic performance

(Terry, 1995). To assess mood in relation to training load, Terry et al. (2007) surveyed athletes from the sports of basketball, golf, hockey, and rowing. Average scores for depression, anger, and fatigue increased as the training load of the athletes increased across all sports. In an endurance setting, the taper period has been associated with a decrease in TMD among cyclists (Zehsaz et al., 2011), rowers (Raglin et al., 1990), swimmers (Raglin et al., 1996), and triathletes (Boucher et al., 2021; Margaritis et al., 2003). However, these research studies were conducted with athletes who were tapering for shorter events, such as a mile swim or 40K time trial. Little to no research has been conducted on athletes who are training for endurance events of much longer duration, such as an Ironman triathlon.

An Ironman triathlon consists of 2.4 miles of swimming, 112 miles of cycling, and 26.2 miles of running, completed consecutively. Training load for an event such as this can vary in regard to time and intensity but typically spans 6 to 12 months of training, with anywhere from 10-20 hours per week, most of which is spent in Zone 1 (i.e., lower-intensity, below aerobic threshold (Lacke, 2022; Muñoz et al., 2014). Participating in such rigorous training can lead to burnout (Gustafsson et al., 2011; Main et al., 2010), which is a psychological syndrome characterized by physical and emotional exhaustion, a reduced sense of accomplishment, and sport devaluation by the athlete (Raedeke, 1997). Athletic engagement (AE) might be an important factor in preventing the development of burnout; indeed, AE has been proposed as the conceptual opposite of burnout (Schaufeli et al., 2002). Although some authors challenge this as an oversimplification (DeFreese & Smith, 2013), there is an inverse relationship between the two constructs (De Francisco et al., 2017; Graña et al., 2021).

Athletic engagement is a state of generalized positive cognitions and affect about one's sport (Curran et al., 2015) that is characterized by the following four dimensions: confidence (i.e., a belief in one's ability to accomplish things in sport), enthusiasm (i.e., feelings of excitement and enjoyment in sport), dedication (i.e., the desire to invest effort and time toward personally meaningful goals in sport), and vigor (i.e., physical, mental, and emotional energy or liveliness; Lonsdale et al., 2007). Collectively, these dimensions create a fulfilling and positive experience that contributes to continued sports participation (Curran et al., 2015) and optimal performance (Swann et al., 2017). To the best of the authors' knowledge, the concept of AE has not been studied in relation to training load and taper in endurance sports.

Nonprofessional, recreational triathletes (i.e., those who do not meet qualifications set forth by USA Triathlon and do not compete for monetary prize winnings; USA Triathlon, n.d.) do not typically have external motivators such as monetary earnings for which to strive in their training and racing, and therefore rely more heavily on intrinsic motivation to propel their training and racing (Boucher et al., 2021; Liddell, 2013). One theory that focuses extensively on intrinsic motivation is Self-Determination Theory (SDT; Deci & Ryan, 1985). SDT is a macro theory of human behavior that provides a theoretical framework for the study of human motivation. According to this theory, the quality of motivation (i.e., whether intrinsic or extrinsic) is critical to both satisfaction and sustained success in achieving one's goals. A mini theory of SDT, Basic Psychological Needs Theory, outlines three essential needs that must be met in order for humans to thrive: autonomy, competence, and relatedness (Standage & Ryan, 2020). It has been hypothesized that the satisfaction of basic psychological needs may represent a likely motivational precursor for AE (Lonsdale et al., 2007). For example, in a sample of 201 elite athletes, basic needs satisfaction (particularly competence and autonomy) was found to predict AE, with 30% explained variance (Lonsdale et al., 2007). SDT aims to explain intrinsic motivation through mechanisms such as goal content, goal satisfaction, social support, and coping strategies. These mechanisms also help to explain individual differences in motivation towards exercise and sport and how individuals approach and manage emotions regarding exercise and sport (Teixeira et al., 2012).

The Present Study

The physiological effects of Ironman training and tapering have been well studied, yet little is known about how these processes affect the mood and engagement of triathletes. This study aimed to explore changes in the mood states and athletic engagement of amateur, nonprofessional triathletes across different time points in the training cycle (i.e., training, taper, and post-race) for an Ironman event. Based upon prior research, we hypothesized that self-reported measures of fatigue, tension, depression, anger, and confusion would decrease during taper and measures of vigor would increase. Overall, positive mood and the four dimensions of AE (i.e., confidence, enthusiasm, dedication, and vigor) were expected to increase during the taper period compared to during training. Finally, despite a lack of research on the relationship between the two, we hypothesized that AE and overall mood would be positively correlated; that is, athletes who experienced high engagement would report better overall mood during the taper period. Conversely, an inverse relationship was expected between AE and TMD.

Method

Design

This study used an Interrupted Time Series (ITS) design. An ITS design is a powerful approach for examining dynamic changes in longitudinal data and is frequently used in clinical and public health research (e.g., Dennis et al., 2013; Stallings-Smith et al., 2013). In an ITS design, data are collected at multiple and equally spaced intervals over time. The time series data is then divided into segments by one or more ‘interruptions’ or change points. Change points are “specific points in time where the values of the time series may exhibit a change from the previously established pattern because of an identifiable interruption, such as a real-world event, policy change, or an experimental intervention” (Wagner et al., 2002, p. 299). In the present study, the interruptions refer to changes in the participant’s training cycle (i.e., from training to taper and from taper to post-race).

Participants

Following institutional IRB approval, participants were recruited via email from local and national triathlon clubs and specific Ironman interest groups on social media in late June 2019. To be eligible to participate, all athletes needed to be racing as a nonprofessional, at least 18 years of age, and training for and planning to race in one of three late-season Ironman races: Ironman Louisville (October 2019), Ironman Florida (November 2019) or Ironman Arizona (November 2019). In order to provide for as many months of data collection as possible prior to race season, recruitment began in June, and the majority of participants began data collection in mid-July 2019. Data collection concluded two weeks after every race. Nineteen triathletes (eight females and 11 males) initially volunteered to participate in the study. All participants provided written informed consent prior to beginning the study. Of the initial 19 participants, eight participants (five females and three males) completed the questionnaire every week throughout the duration of the study and were retained for analysis. Those participants who either did not complete the study or missed multiple weeks of data collection were, therefore, omitted from the analysis. These participants did not provide specific reasons for attrition; however, two stopped answering the weekly questionnaires immediately following illness or injury.

Due to the difference in training and racing schedules, the exact number of time points for each participant varied despite their completion of questionnaires every week. For example, some participants reported competing in races of shorter distances during the preparation period for Ironman, with some periods of rest before and/or after these races. These periods did not fall under the operational definition of taper (i.e., the 14 days prior to the goal Ironman competition) and were considered to be part of the Ironman training process. For consistency, only the training, taper, and post-race data for the specified late-season Ironman were included in the analysis.

The average age of the eight participants was 46 ± 12 years. All participants were competing in nonprofessional, age-group divisions and were training for one of the three aforementioned late-season Ironman races. Six participants reported that this was their first Ironman event. Five participants had a coach, and two were self-trained. Descriptive data for the participants can be found in Table 1.

All measures were distributed electronically using Qualtrics. Prior to beginning the study, demographic information was collected using a survey. Demographic information such as marital, parental, and employment status were collected from participants using a questionnaire in order to describe the sample fully. Although we did not analyze these factors in regard to this study, it is acknowledged that they could also contribute to individual differences in mood and/or engagement fluctuations.

Participants’ mood state was measured using the Brunel Mood Scale (BRUMS; Terry et al., 1999). The BRUMS is a 24-item inventory that uses a Likert scale ranging from 0 (not at all) to 4 (extremely) to assess levels of six subscales: tension, depression, anger, fatigue, confusion, and vigor. For the present study, participants responded to one-word statements that described how they felt at that exact moment. Words included relaxed, lively, and downhearted. Certain words align to specific subscales, and each subscale is scored by averaging the numeric rating for each answer. In order to calculate TMD, the negative subscales (tension, depression, anger, fatigue, and confusion) are subtracted from the positive subscale (vigor). Thus, a higher (or less negative) score represents less mood disturbance. The BRUMS was adapted from the Profile of Mood States (McNair et al., 1971) for use with non-clinical populations. The BRUMS has been validated with samples of adults, adolescents, and athletes in multiple languages and has been shown to have good internal consistency (Brandt et al., 2016;

Table 1. Participant Demographics

2019 Age Group	Gender	Ethnicity	Marital Status	Parental Status	Current Employment Status	Annual household income	Use of Training Software	Work with a coach	Race goals	Completed Ironman Races
60-64	Female	White	Married	2 children age 18+	Full-time (40+ hours per week)	above $150,000	Yes	Yes	• To finish • To finish under the cutoff time	1-3
55-59	Male	White	Married	2 children age 18+	Retired	$50,000-$99,999	Yes	No	• To finish • To finish in/around a specific time	0
25-29	Male	White	Single	No	Full-time (40+ hours per week)	$50,000-$99,999	No	No	• To finish • To finish in/around a specific time	0
45-49	Male	Hispanic or Latino	Single	2 children age 18+	Self-employed	$10,000-$49,999	Yes	Yes	• To finish	0
50-54	Female	Hispanic or Latino	Married	No	Full-time (40+ hours per week)	$50,000-$99,999	Yes	Yes	• To finish	0
45-49	Female	White	Married	No	Full-time (40+ hours per week)	$50,000-$99,999	Yes	Yes	• To finish in/around a specific time	0
45-49	Female	White	Married	2 children age 18+	Other	above $150,000	Yes	Yes	• To finish	0
25-29	Female	White	Married	No	Full-time (40+ hours per week)	$50,000-$99,999	Yes	No	• To finish in/around a specific time • To get a PR	0

Lan et al., 2012; Terry et al., 1999; Terry et al., 2003) and be sensitive to changes in training load (Anglem et al., 2008). In the present study, Cronbach's alpha levels of .72 to .91 indicated satisfactory internal consistency for the BRUMS subscales and for the TMD score (.87).

Overall mood was assessed using a single item which asked participants to rate their overall mood for the past week on a scale of 0 (very unpleasant) to 10 (very pleasant). This additional mood measure was used to capture fluctuations in positive mood that would not be reflected in TMD scores. Single-item scales have been successfully used for global assessment of mood in a number of studies; Tenenbaum et al. (2007) provided a strong rationale for the applicability of single-item scales where they demonstrate high face validity.

AE was measured using the Athlete Engagement Questionnaire (AEQ; Lonsdale et al., 2007). The AEQ assesses four subscales: confidence, dedication, vigor, and enthusiasm. Statements include "I feel capable of success in my sport" (confidence), "I want to work hard to achieve my goals in my sport" (dedication), "I feel really alive when I participate in my sport" (vigor) and "I feel excited about my sport" (enthusiasm). Participants are asked to rate their level of agreement with each statement on a scale of 0 (not at all) to 4 (extremely) based on how they feel about their current participation in sport. Each of the subscales has four items that align with it, and scores for each item are averaged to calculate a score for each subscale (range = 0-16). A global AE score is calculated by averaging scores across the four subscales. Factorial validity of the subscales is strong, ranging from .71 to .91 (De Francisco et al., 2017; Lonsdale et al., 2007; Martins et al., 2014). In the present study, Cronbach's alpha levels of .93 to .97 indicated satisfactory internal consistency for the AEQ subscales and for the global score (.95).

In order to quantify physical demands at the time that the questionnaire was distributed, participants also reported their weekly training load and competitions. When the athletes self-reported that they were tapering (about two weeks prior to their race), an additional question was added regarding their goal(s) for the race (e.g., to finish, to finish in a specific time, to qualify for Kona).

Procedures

Training for an Ironman typically requires many months of training and preparation; therefore, data collection spanned five to six months, which included the training period leading up to the race, the taper period, and several weeks following the event in order to capture any post-race fluctuations in mood and AE. To avoid a possible threat of reactivity, participants were informed that the research goal was to study mood fluctuations over the course of a training cycle, and information about the importance of the taper period was not revealed.

Participants were asked to complete the BRUMS, AEQ, and a measure of overall mood once per week for the duration of the study. A reminder email with the Qualtrics link was sent to participants each week. Participants were asked to complete the questionnaires on the same day of the week, at approximately the same time of day, given that mood can fluctuate throughout the course of a day due to factors such as circadian rhythm and caloric intake (Triantafillou et al., 2019; Swami et al., 2022).

Statistical Analysis

The independent variable for this study was the time point in the athletes' training cycle (i.e., training, taper, and post-race), with a particular focus on the one to two weeks leading up to an Ironman race. The dependent variables were the separate scores of all the individual BRUMS subscales (tension, depression, anger, fatigue, vigor, and confusion) and AEQ subscales (confidence, dedication, vigor, and enthusiasm), as well as the overall mood score. Subscales and the overall mood scale were examined separately from one another, and individual scores were plotted for each week, within every time period (training, taper, and post-race) that the questionnaire was administered. Therefore, the analysis generated 11 different time series plots for each participant; however, only significant findings are included in the results of this study. Data for this study were analyzed using a segmented time series regression model with two change-points (Zhang et al., 2020) in the statistical software R (RStudio Team, 2019). In this approach, a general linear model is used to estimate the mean level of each dependent variable for a baseline period of observation and to estimate mean changes in the mean level following one or more interruptions in the time series.

The present study analyzed changes in each participant's mood and engagement scores during the taper period (relative to the training period) and the post-race period (relative to the training period). The presence of autocorrelation, that is, the autoregressive moving average (ARMA) order, was determined for each of the 88 time series analyzed (eight participants, 11 dependent variables) using autocorrelation function

(ACF) and partial autocorrelation function (PACF) plots in R. Each individual time series was analyzed based on the ARMA order reflected by these plots (Chatfield, 1996). For example, a time series with plots showing a gradually declining ACF and a significant PACF at a particular time lag would indicate an autoregressive (AR) order, whereas the reverse (i.e., gradually declining PACF, significant ACF) would indicate a moving average (MA) order. Time series with non-significant ACF and PACF would indicate no autocorrelation. Seasonality, which is the presence of cyclical patterns in the data (Chatfield, 1996), was not included in the analysis based on the timescale on which data were collected. Data were collected weekly for a several-month period, so the presence of weekly (if measuring more frequently, e.g., daily) or yearly cycles would not have been relevant in the current study. There may be changes in an individual's overall mood associated with changes in season (e.g., summer to fall), which is a potential limitation of the study. However, it is not a manifestation of seasonality as defined in the time series literature (Chatfield, 1996). Finally, bivariate correlations were used to explore the relationship between AEQ subscales, BRUMS subscales, TMD, global AE, and overall mood during the taper period.

Results

ACF and PACF plots showed no presence of autocorrelation for 81 out of 88 (92%) of the time series, so these data were analyzed without the inclusion of any ARMA parameters. Eight out of 88 (8%) time series reflected a first-order autoregressive (AR1) process as evidenced by a PACF significant at lag one but non-significant thereafter and a gradually declining ACF. These eight time series[1] were analyzed by including AR1 coefficients to control for autocorrelation. Time series regression models were run for each participant and each dependent variable to estimate mean changes across the entire training, tapering, and post-race cycle. Eight out of the 88 analyses resulted in perfect model fit resulting from scores that showed no variability across all observations (e.g., a persistent score of 0 for confusion). These eight analyses were discarded[2].

Time series regression analysis of the data collected from the eight participants revealed no overall trends in changes in engagement and mood throughout training, taper, and post-race. However, some participants individually experienced significant ($p < .05$) changes in areas of mood and engagement during taper and post-race as compared to training.

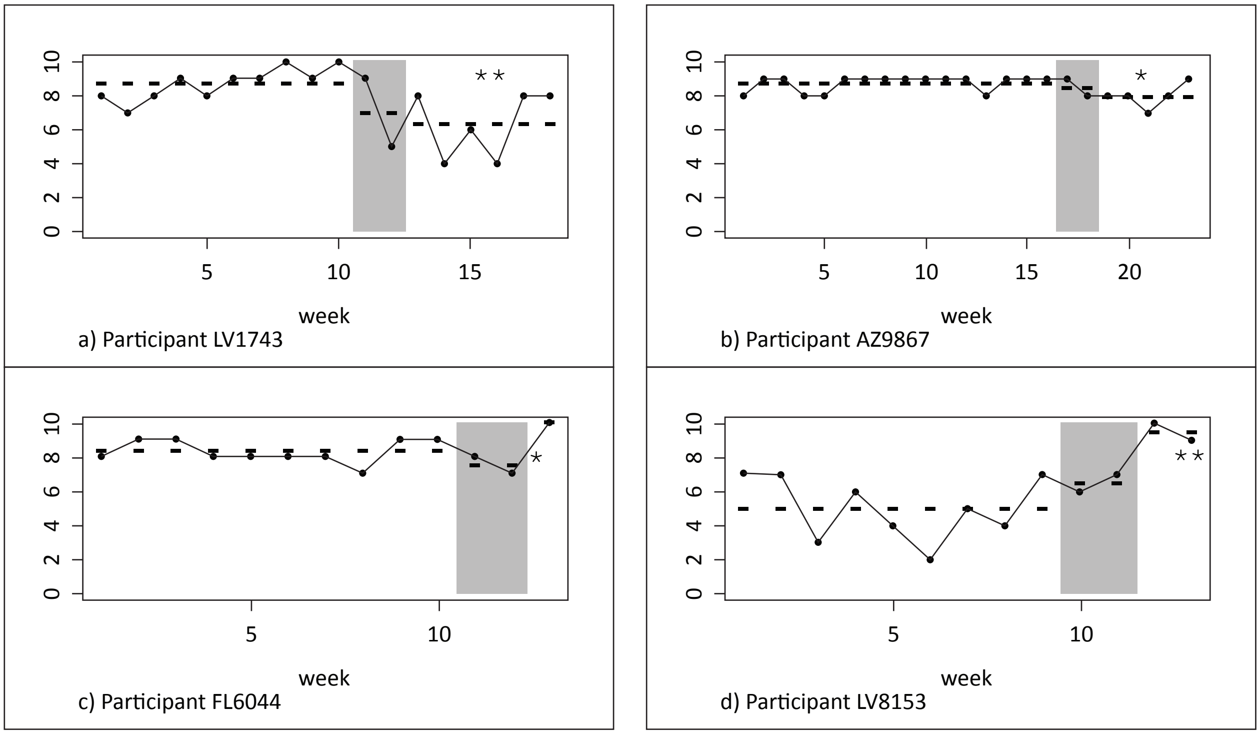
Relative to training, participant LV1743 showed a large post-race decline in overall mood (b = -2.37, 95% CI [-4.06, -.67], p = .009, see Figure 1a). Participant AZ9867 also showed a decrease in overall mood post-race (b = -.75, 95% CI [-1.31, -.19] p = .011, see Figure 1b). In contrast, participants FL6044 and LV8153 both showed an increase (i.e., improvement) in overall mood post-race (b = 1.70, 95% CI [.12, 3.28], p = .038, and b = 4.50, 95% CI [1.53, 7.47], p = .007, respectively. see Figure 1c and Figure 1d). There were no significant changes in overall mood during taper. When examining BRUMS subscale scores, LV1743 showed a decrease in fatigue post-race (b = -.78, 95% CI [-1.48, -.07], p = .033, see Figure 2a) as did LV8153 (b = -1.60, 95% CI [-2.7, -.50], p = .009, see Figure 2b) and AZ2014 (b = -.56, 95% CI [-1.07, -.05], p = .03, see Figure 2c). Participant LV2766 showed an increase in tension during taper, relative to the training period (b = 1.05, 95% CI [.38, 1.72], p = .005, see Figure 3a), whereas participant LV8153 showed a decrease in tension post-race (b = -2.06, 95% CI [-3.75, -.36], p = .022, see Figure 3b). Participant AZ2104 showed an increase in depression post-race (b = .36, 95% CI [.07, .65], p = .017, see Figure 4a). Participant AZ9867 also showed an increase in depression post-race (b = .20, 95% CI [.04, .36], p = .014, see Figure 4b), as well as an increase in confusion while tapering (b = .23, 95% CI [.06, .41], p = .012) and following the race (b = .13, 95% CI [.01, .26], p = .032, see Figure 5a). Participant AZ2014 showed an increase in confusion post-race (b = .20, 95% CI [.01, .40], p = .04, see Figure 5b). Participant LV1743 showed an increase in anger post-race (b = .84, 95% CI [.22, 1.46], p = .011, see Figure 6). Participant FL7943 showed a significant post-race increase in confidence (b = 1.41, 95% CI [.71, 2.10], p = .0005, see Figure 7).

Correlations among overall mood, TMD, and global AE and the means of each subscale of the BRUMS and AEQ were calculated for the taper period. The bivariate correlation between TMD and global AE (r = -.62) showed a strong but non-significant (p = .105) negative relationship. Overall, mood was significantly negatively correlated with TMD (r = -.72, p = .045) and positively correlated with global AE (r = .73, p = .040). A complete correlation matrix can be found in Table 2.

[1] AZ2104 dedication; AZ9876 enthusiasm, vigor; FL7943 confidence, confusion; LV1743 dedication; LV7332 tension

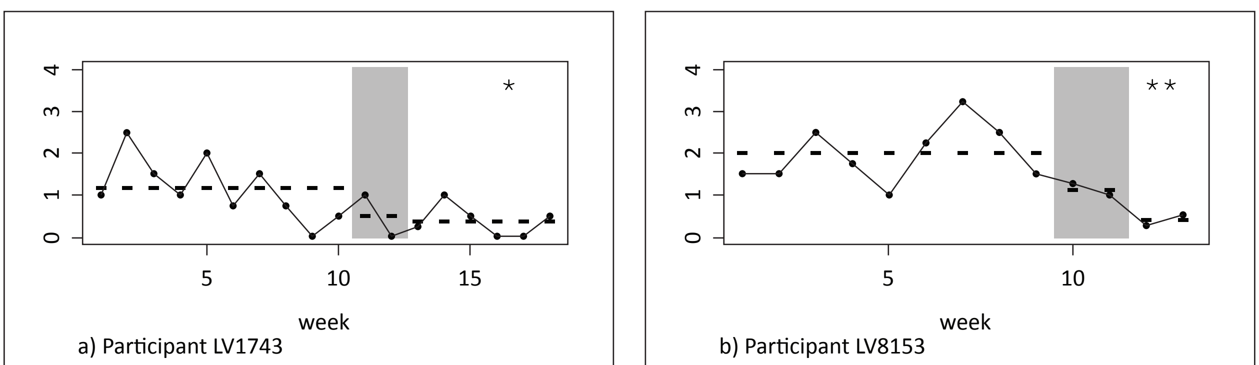
[2] AZ9867 anger, confidence; LV1743 confusion; LV7332 confusion, confidence, dedication, enthusiasm, vigor

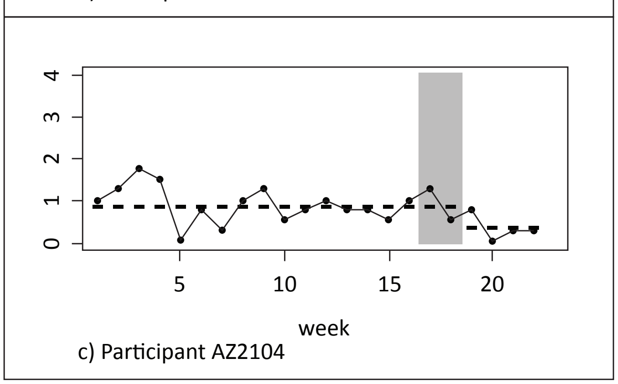
Figure 1. Overall Mood



Note. The grey shaded area indicates the taper period.
* Change in average scores relative to training is significant at $p < .05$.
** Change in average scores relative to training is significant at $p < .01$.

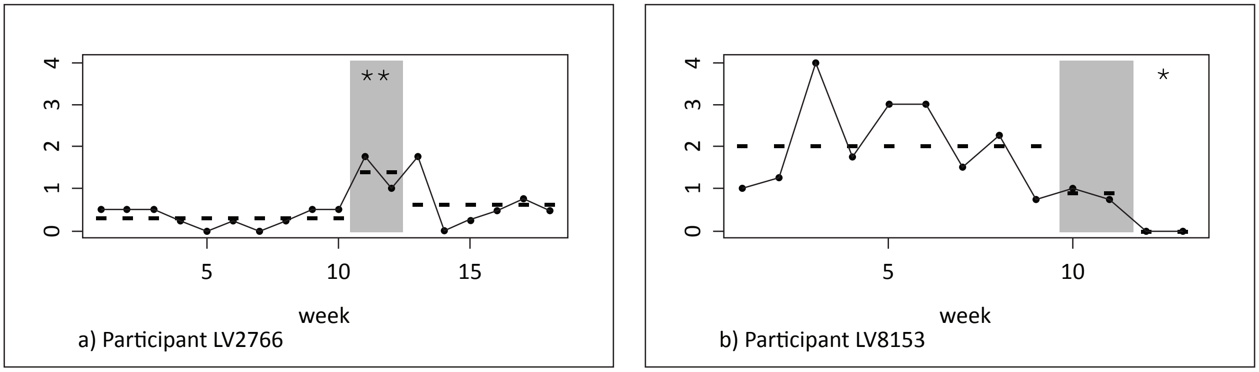
Figure 2. Fatigue





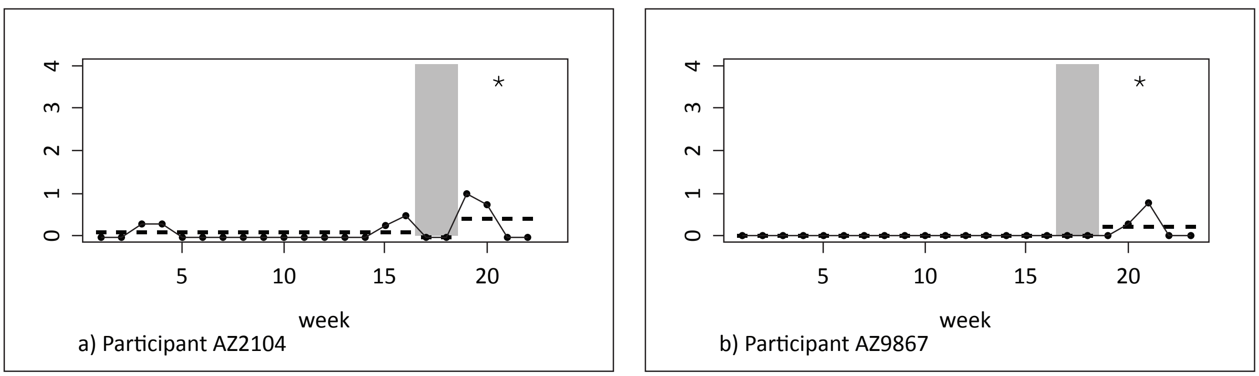
Note. The grey shaded area indicates the taper period.
* Change in average scores relative to training is significant at $p < .05$.
** Change in average scores relative to training is significant at $p < .01$.

Figure 3. Tension



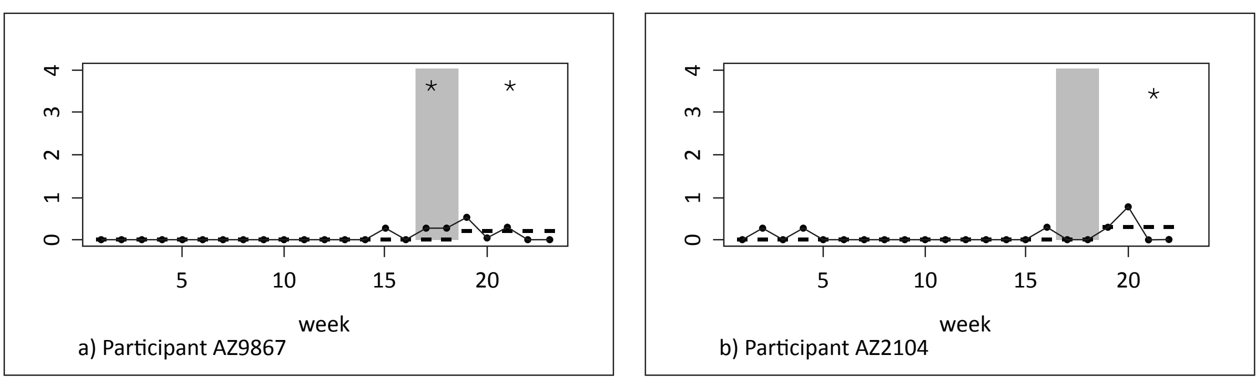
Note. The grey shaded area indicates the taper period.
* Change in average scores relative to training is significant at $p < .05$.
** Change in average scores relative to training is significant at $p < .01$.

Figure 4. Depression



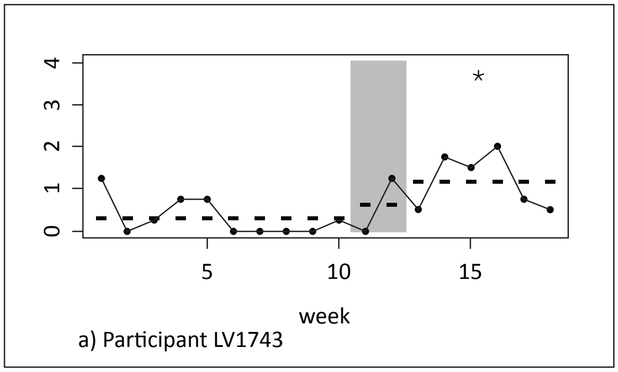
Note. The grey shaded area indicates the taper period.
* Change in average scores relative to training is significant at $p < .05$.

Figure 5. Confusion



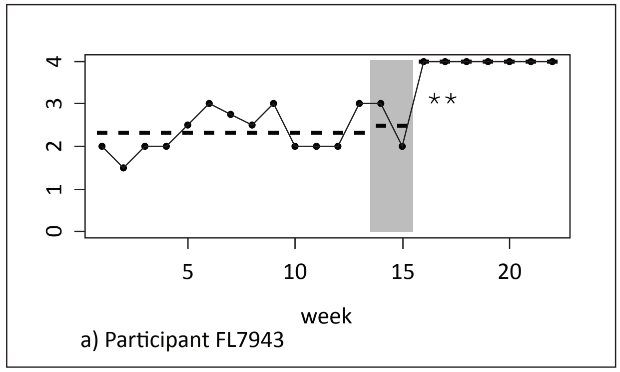
Note. The grey shaded area indicates the taper period.
* Change in average scores relative to training is significant at $p < .05$.

Figure 6. Anger



Note. The grey shaded area indicates the taper period.
* Change in average scores relative to training is significant at $p < .05$.

Figure 7. Confidence



Note. The grey shaded area indicates the taper period.
* Change in average scores relative to training is significant at $p < .05$.
** Change in average scores relative to training is significant at $p < .01$.

Table 2. Correlation between scales and subscales

	1	2	3	4	5	6	7	8	9	10	11	12
1. Vigor†												
2. Anger†	-.49											
3. Depression†	-.65	.43										
4. Tension†	-.58	-.25	.20									
5. Fatigue†	.02	-.65	.09	.57								
6. Confusion†	-.82*	.33	.77*	.61	.11							
7. Confidence‡	.19	-.37	-.60	-.10	.08	-.63						
8. Dedication‡	.36	-.45	-.22	-.02	.60	-.36	.46					
9. Vigor‡	.71	-.23	-.47	-.50	.12	-.78*	.45	.77*				
10. Enthusiasm‡	.73*	-.26	-.55	-.49	.11	-.81*	.50	.75*	.99**			
11. TMD	-.90**	.32	.77*	.72*	.30	.93**	-.44	-.20	-.65	-.70		
12. Global AE	.61	-.36	-.55	-.36	.22	-.78*	.69	.84**	.95**	.96**	-.63	
13. Overall mood	.81**	-.77*	-.53	-.32	.28	-.71*	.48	.62	.70*	.71*	-.72*	.73*

Note. † BRUMS subscales, ‡ AEQ subscales, * Correlation is significant at the 0.05 level (2-tailed),
** Correlation is significant at the 0.01 level (2-tailed).

Discussion

The training that is required for the completion of an Ironman is long and rigorous and typically culminates in a taper period prior to a race. Previous research has shown that tapering for an endurance event can produce beneficial physiological adaptations; however, little is known about the psychological changes that occur when athletes transition from training to the pre-race taper.

The main hypothesis of the present study was that fatigue, tension, depression, anger, and confusion would decrease and vigor would increase during taper as compared to training. Overall mood scores and AEQ subscale scores were also expected to increase during the taper period compared to training. These hypotheses were not supported by all participants. The results of the data analysis showed that although there were no overall trends, there were some significant changes that varied among the participants. Although all participants whose data were analyzed experienced at least one change in mood or engagement measures, these changes varied in a between-participant manner. For example, with regard to fatigue, only two out of the eight participants experienced changes throughout the training, tapering, and post-race cycle. One of the participants, AZ2104, experienced no change in fatigue while tapering, which decreased post-race, whereas both LV1743 and LV1853 experienced a decrease in fatigue during taper that continued to decrease post-race.

Previous research with runners has demonstrated that performance expectations and goal realization have an influence on post-competition mood (Micklewright et al., 2009; Waleriańczyk et al., 2022). Changes in post-competition mood, as well as the magnitude of those changes, were associated with the extent of the discrepancy between how ultramarathon runners expected to perform and how they actually performed (Micklewright et al., 2009). Therefore, athletes who believed that they had a positive performance during competition might be expected to experience positive mood states following the competition as compared to those who believed that they had a negative performance. Although we did not include goal content and performance evaluation in our analysis, these are factors that influence motivation and potential mechanisms that may have impacted changes in mood and engagement for athletes during the taper and post-race periods. Another component of SDT is the basic psychological needs of autonomy, competence, and relatedness (Deci & Ryan, 1985). Research has shown that satisfaction of these needs improves engagement of athletes and/or reduces burnout by positively impacting their self-determined, or intrinsic, motivation (De Francisco et al., 2018; di Luzio et al., 2020). Although little is known about the relationship between mood and motivation in nonprofessional athletes, mood and motivation to succeed share a positive association for elite athletes (Ekici, 2011), as do mood/affective states and performance in pentathletes (Samełko & Goszkowska, 2016) and swimmers (Samełko et al., 2018).

We expected that athletes with higher global AE scores would show lower TMD during the taper phase. A large negative correlation indicated that the relationship between AE and TMD was in the expected direction. However, the relationship was non-significant; therefore, the second hypothesis was not supported. We also hypothesized that athletes with a higher (i.e., more positive) overall mood would show a lower TMD score. Results indicated a significant negative relationship between the two, meaning that this hypothesis was supported. When looking at the relationship between the different subscales, three items of the AEQ were highly correlated with each other, which is in line with prior studies (e.g., Martins et al., 2014). That is, athletes who were more dedicated to their training during the taper period also felt more enthusiastic, vigorous, and confident during the taper period. BRUMS subscale items have been previously reported (e.g., Lan et al., 2012); however, the negative correlations of those subscales with enthusiasm, global AE, and overall mood are novel findings that warrant further study. In particular, scores for confusion also shared a relationship with several other variables; confusion was positively correlated with depression and was negatively correlated with vigor, enthusiasm, global AE, and overall mood. Previous authors have suggested that increased confusion prior to an endurance event indicates an anticipatory affective state that may be a consequence of participants' thoughts about their pre-race circumstances and the impending start of the race (Micklewright et al., 2009). Exploration of Ironman triathletes' pre-race cognitions may shed light on the findings of the present study.

Limitations and Future Directions

A limitation of this study was the difference in length of time between the three different periods of the training cycle. Although training and most post-race periods spanned several weeks, the taper period was only two weeks and, therefore, only contained two data points. More frequent data collection could have enabled the researcher to detect more specific changes in participants' mood and athletic engagement during the taper period. Two data points are also below the number recommended for segmented analysis in an ITS design, rendering the analysis underpowered (Zhang et al., 2020). That being said, although daily data collection during the taper period would have increased power, for the sake of consistency and in consideration of participant burden, we maintained weekly data collection versus daily data collection. Results should, therefore, be interpreted cautiously. Similarly, with a small sample size of eight participants who completed the study, the correlational analyses should be interpreted with caution and ought to be considered exploratory.

As an initial exploratory study, this study addressed a variety of factors that have little to no representation in previous research on training and tapering. For example, other studies have looked at this concept in cyclists, swimmers, and runners (e.g., Muijka et al., 2012; Myers et al., 2017; Zehsaz et al., 2011) but have paid less attention to Ironman athletes or triathletes as a whole. In addition, research has typically been experimental, in which the training of the participants was manipulated by the researchers, as opposed to observational, where participants self-report their training and comparisons are made in regard to outcome measures (Bosquet et al., 2007). Based on previous literature and the results of the present study, it is clear that more research needs to be conducted with Ironman athletes to understand the psychological effects of training for an event of this magnitude. It is also worth investigating the relationship between athlete and coach and how this might impact the taper experience. Future applied research might involve working with coaches to make sure they can identify specific psychological changes throughout the training cycle, communicate with their athletes, and act accordingly to accommodate personal needs.

Due to the fact that changes in mood fluctuations varied between participants, it is recommended that demographic factors should be evaluated on an individual level and compared to the dependent variables. These factors might include the number of previously completed Ironman races, age, and socioeconomic status, as they may provide a different experience throughout training, tapering, and racing. Another important consideration for future investigations is performance expectations and outcomes. According to Micklewright et al. (2009), performance expectations have a strong influence on post-race mood. In their study of ultrarunners, a greater discrepancy between runners' predicted and actual performance was associated with higher post-race TMD. From the data we collected, it is not possible to account for the influence of predicted and actual performance on post-race mood; however, this may be one reason for the variation observed and should be considered in future studies.

Conclusion

The current study demonstrates that training and tapering for an Ironman is a unique experience that differs across participants, and an individual approach is recommended. The main implication from these findings is that the process for beginning to identify and monitor moods and relating that information to training engagement is one that should ideally begin when daily training begins and continues throughout the taper period. This information can then be used to determine the most effective methods to overcome behaviors or feelings that could hinder athletic performance and/or athlete well-being. For example, one athlete might demonstrate higher levels of tension and anxiety while they are tapering and could benefit from relaxation techniques, whereas another athlete may demonstrate an increase in depression or confusion during taper and could benefit from confidence and reframing techniques. Both athletes are experiencing adverse effects of tapering but would require different approaches and methods to improve their experiences. This knowledge is valuable for coaches and mental performance consultants, as well as nonprofessional athletes who monitor their training without the oversight of a coach or mental performance consultant. Being prepared to experience mood fluctuations as a normal part of the taper process and having resources planned for positive coping with whatever fluctuations one experiences can make the final days leading up to an Ironman triathlon less unexpected and reduce potentially negative interpretations of the experience.

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References

Anglem, N., Lucas, S. J. E., Rose, E. A., & Cotter, J. D. (2008). Mood, illness and injury responses and recovery with adventure racing. *Wilderness & Environmental Medicine, 19*(1), 30–38. https://doi.org/10.1580/07-WEME-OR-091.1

Bosquet, L., Montpetit, J., Arvisais, D., & Mujika, I. (2007). Effects of tapering on performance: A meta-analysis. *Medicine and Science in Sports and Exercise, 39*(8), 1358–1365. https://doi.org/10.1249/mss.0b013e31806010e0

Boucher, V. G., Caru, M., Martin, S., Lopes, M., Comtois, A. S., & Lalonde, F. (2021). Psychological status during and after the preparation of a long-distance triathlon event in amateur athletes. *International Journal of Exercise Science, 14*(5), 134–148.

Brandt, R., Herrero, D., Massetti, T., & Crocetta, T. B., Guarnieri, R., de Mello Monteiro, C. B., da Silveira Viana, M., Bevilacqua, G. G., de Abreu, L. C., & Andrade, A. (2016). The Brunel Mood Scale rating in mental health for physically active and apparently healthy populations. *Health, 8*(2), 125–132. https://doi.org/10.4236/health.2016.82015

Chatfield, C. (1996). *The analysis of time series: An introduction.* Chapman & Hall/CRC.

Curran, T., Hill, A. P., Hall, H. K., & Jowett, G. E. (2015). Relationships between the coach-created motivational climate and athlete engagement in youth sport. *Journal of Sport & Exercise Psychology, 37*(2), 193–198. http://dx.doi.org/10.1123/jsep.2014-0203

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

De Francisco, C., Arce, C., & Graña, M. (2017). Preliminary validation of a Spanish version of the Athlete Engagement Questionnaire (AEQ). *Journal of Sport Psychology, 26*(4), 22–27.

De Francisco, C., Arce, C., Sánchez-Romero, E. I., & del Pilar Vílchez, M. (2018). The mediating role of sport self-motivation between basic psychological needs satisfaction and athlete engagement. *Psicothema, 30*(4), 421–426. https://doi.org/10.7334/psicothema2018.117

DeFreese, J. D., & Smith, A. L. (2013). Areas of worklife and the athlete burnout-engagement relationship. *Journal of Applied Sport Psychology, 25*(2), 180–196. https://doi.org/10.1080/10413200.2012.705414

Dennis, J., Ramsay, T., Turgeon, A. F., & Zarychanski, R. (2013). Helmet legislation and admissions to hospital for cycling related head injuries in Canadian provinces and territories: Interrupted time series analysis. *BMJ, 346*, 1–10. https://doi.org/10.1136/bmj.f2674

di Luzio, S. S., Martinent, G., Guillet-Descas, Daigle, M. (2020). Exploring the role of sport sense of community in perceived athlete burnout, sport motivation, and engagement. *Journal of Applied Sport Psychology, 32*(5), 513–528. https://doi.org/10.1080/10413200.2019.1575298

Ekici, S. (2011). The effect of positive and negative mood on motivation to succeed of elite athletes. *International Journal of Human Sciences, 8*(2), 946–962.

Graña, M., De Francisco, C., & Arce, C. (2021). The relationship between motivation and burnout in athletes and the mediating role of engagement. *International Journal of Environmental Research and Public Health, 18*(9), 4884. https://doi.org/10.3390/ijerph18094884

Grivas, G. V. (2018). The effects of tapering on performance in elite endurance runners: A systematic review. *International Journal of Sport Science, 8*(1), 8–13. https://doi.org/10.5923/j.sports.20180801.02

Gustafsson, H., Kenttä, G., & Hassmén, P. (2011). Athlete burnout: An integrated model and future research directions. *International Review of Sport and Exercise Psychology, 4*(1), 3–24. https://doi.org/10.1080/1750984X.2010.541927

Hutchinson, J. C., & Jones, L. (2020). Affect and music. In D. Hackfort & R. J. Schinke (Eds.), *The Routledge International Encyclopedia of Sport and Exercise Psychology: Volume 2: Applied and Practical Measures* (pp. 21–36). Routledge.

Lacke, S. (2022, April 19). *Triathlete's complete guide on how to train for an Ironman.* Triathlete. Retrieved February 13, 2023, from https://www.triathlete.com/training/triathletes-complete-guide-on-how-to-train-for-an-ironman/

Lan, M. F., Lane, A. M., Roy, J., & Hanin, N. A. (2012). Validity of the Brunel Mood Scale for use with Malaysian athletes. *Journal of Sport Science and Medicine, 11*(1), 131–135.

Liddell, T. M. (2013). *Exploring the motives, experiences, and transformations of non-professional IRONMAN athletes* (Publication No. 151962) [Doctoral dissertation, Arizona State University]. ASU Electronic Theses and Dissertations.

Lonsdale, C., Hodge, K., & Jackson, S. (2007). Athlete engagement: II. Development and initial validation of the Athlete Engagement Questionnaire. *International Journal of Sport Psychology, 38*(4), 471–492.

Main, L. C., Landers, G. J., Grove, J. R., Dawson, B., & Goodman, C. (2010). Training patterns and negative health outcomes in triathlon: Longitudinal observations across a full competitive season. *The Journal of Sports Medicine and Physical Fitness, 50*(4), 475–485.

Margaritis, I., Palazzetti, S., Rousseau, A. S., Richard, M. J., & Favier, A. (2003). Antioxidant supplementation and tapering exercise improve exercise-induced antioxidant response. *Journal of the American College of Nutrition (22)*2, 147–156. https://doi.org/10.1080/07315724.2003.10719288

Martins, P., Rosado, A., Ferreira, V., & Biscaia, R. (2014). Examining the validity of the Athlete Engagement Questionnaire (AEQ) in a Portuguese sport setting. *Motriz, Rio Claro, 20*(1), 1–7. https://doi.org/10.1590/S1980-65742014000100001

McNair, D. M., Lorr, M., & Droppleman, L. F. (1971). *Profile of Mood States (POMS) Manual*. Education and Industrial Testing Service.

McNair, D. M., Lorr, M., & Droppleman, L. F. (1992). *Profile of mood states – revised*. Educational and Institutional Testing Service.

Micklewright, D., Papadopoulou, E., Parry, D., Hew-Butler, T., Tam, N., & Noakes, T. (2009). Perceived exertion influences pacing among ultramarathon runners but post-race mood change is associated with performance expectancy. *South African Journal of Sports Medicine, 21*(4), 167–172.

Mølmen, K. S., Øfsteng, S. J., & Rønnestad, B. R. (2019). Block periodization of endurance training: A systematic review and meta-analysis. *Open Access Journal of Sports Medicine, 10*, 145–160. https://doi.org/10.2147/OAJSM.S180408

Morgan. M. (1980). Test of champions: The iceberg profile. *Psychology Today, 14*, 92- 108.

Mujika, I., Padilla, S., Pyne, D. B., & Busso, T. (2004). Physiological changes associated with the pre-event taper in athletes. *Sports Medicine, 34*, 891–927. https://doi.org/10.2165/00007256-200434130-00003

Muñoz, I., Cejuela, R., Seiler, S., Larumbe, E. & Esteve-Lanao, J. (2014). Training-intensity distribution during an Ironman season: Relationship with competition performance. *International Journal of Sports Physiology and Performance, 9*(2), 332–339. http://dx.doi.org/10.1123/IJSPP.2012-0352

Myers, V.R., McKillop, A. L., Fraser, S. J., Abel, J. M., Wells, G. D. (2017). Physical and psychological adaptations during taper in competitive swimmers. *International Journal of Sport Science and Coaching, 12*(4), 481–494. https://doi.org/10.1177/1747954117717878

Raedeke, T. D. (1997). Is burnout more than stress? A sport commitment perspective. *Journal of Sport and Exercise Psychology, 19*(4), 396–417. https://doi.org/10.1123/jsep.19.4.396

Raglin, J. S., Koceja, D. M., Stager, J. M., & Harms, C. A. (1996). Mood, neuromuscular function, and performance during training in female swimmers. *Medicine and Science in Sports and Exercise, 28*(3), 372–377. https://doi.org/10.1097/00005768-199603000-00013

Raglin, S., Morgan, W. P., & Luchsinger, A. E. (1990). Mood and self-motivation in successful and unsuccessful female rowers. *Medicine and Science in Sports and Exercise, 22*(6), 849–853. https://doi.org/10.1249/00005768-199012000-00018

RStudio Team. (2019). RStudio: Integrated Development for R. RStudio, Inc. http://www.rstudio.com/.

Samełko, A. & Guskowska, M. (2016). Affective states and performance outcomes: The findings of preliminary research involving pentathletes. *Polish Journal of Sport Tourism, 23*(1), 21–24. https://doi.org/10.1515/pjst-2016-0003

Samełko, A., Guskowska, M., & Gala-Kwiatokowska, A. (2018). Affective states influence performance in swimming. *Polish Journal of Sport Tourism, 25*(4), 21-26. https://doi.org/10.2478/pjst-2018-0023

Schaufeli, W. B., Salanova, M., González-Romá, V., & Bakker, A. B. (2002). The measurement of engagement and burnout: A two sample confirmatory factor analytic approach. *Journal of Happiness Studies, 3*(1), 71–92. https://doi.org/10.1023/A:1015630930326

Stallings-Smith, S., Zeka, A., Goodman, P., Kabir, Z., & Clancy, L. (2013). Reductions in cardiovascular, cerebrovascular, and respiratory mortality following the national Irish smoking ban: Interrupted time-series analysis. *PloS One, 8*(4), e62063. https://doi.org/10.1371/journal.pone.0062063

Standadge, M. & Ryan, R. M. (2020). Self-Determination Theory in sport and exercise. In G. Tenenbaum & R. Eklund (Eds.), *Handbook of Sport Psychology* (4th ed., pp. 37-56). Wiley. https://doi.org/10.1002/9781119568124.ch3

Swami, V., Hochstöger, S., Kargl, E. & Stieger, S. (2022). Hangry in the field: An experience sampling study on the impact of hunger on anger, irritability, and affect. *PLoS One, 17*(7), 1–17. http://doi.org/10.1371/journal.pone.0269629

Swann, C., Crust, L., Jackman, P., Vella, S. A., Allen, M. S., & Keegan, R. (2017). Psychological states underlying excellent performance in sport: Toward an integrated model of flow and clutch states. *Journal of Applied Sport Psychology, 29*(4), 375–401. https://doi.org/10.1080/10413200.2016.1272650

Tenenbaum, G., Kamata, A., & Hayashi K. (2007). Measurement in sport and exercise psychology: A new outlook on selected issues of reliability and validity. In G. Tenenbaum & R. Eklund (Eds.). *Handbook of Sport Psychology* (3rd ed., pp. 757–773). Wiley. https://doi.org/10.1002/9781118270011.ch34

Terry, P. (1995). The efficacy of mood state profiling with elite performers: A review and synthesis. *The Sport Psychologist, 9*(3), 309–324. https://psycnet.apa.org/doi/10.1123/tsp.9.3.309

Terry, P. C., Galambos, S. A., West, J. & Iizuka, C. A. (2007). Psychological correlates of training load among athletes. *Proceedings of the 42nd Australian Psychological Society Annual Conference: Psychology Making an Impact*. Australian Psychological Society. https://research.usq.edu.au/item/9yw16/psychological-correlates-of-training-load-among-athletes

Terry, P. C., Lane, A. M., & Fogarty, G. J. (2003). Construct validity of the Profile of Mood States: Adolescents for use with adults. *Psychology of Sport and Exercise, 4*(2), 125–139. https://doi.org/10.1016/S1469-0292(01)00035-8

Terry, P. C., Lane, A. M., Lane, H. J., Keohane, L. (1999). Development and validation of a mood measure for adolescents. *Journal of Sport Sciences, 17*(11), 861–872. https://doi.org/10.1080/026404199365425

Teixeira, P. J., Carraça, E. V., Markland, D., Silva, M. N., & Ryan, R. M. (2012). Exercise, physical activity, and self-determination theory: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity, 9*(78), 1–30. https://doi.org/10.1186/1479-5868-9-78

Triantafillou, S., Saeb, S. Lattie, E. G., Mohr, D. C., & Kording, K. P. (2019). Relationship between sleep quality and mood: Ecological momentary assessment. *JMIR Mental Health, 6*(3), 1–18. https://doi.org/10.2196/12613

USA Triathlon (n.d.). *Elite Development.* https://www.usatriathlon.org/our-community/elite-development

Wagner, A. K., Soumerai, S. B., Zhang, F., & Ross-Degnan, D. (2002). Segmented regression analysis of interrupted time series studies in medication use research. *Journal of Clinical Pharmacy and Therapeutics, 27*(4), 299–309. https://doi.org/10.1046/j.1365-2710.2002.00430.x

Waleriańczyk, W., Stolarski, M., & Matthews, G. (2022). Perfectionism moderates the effects of goal-realization on post-competition mood in amateur runners. *Journal of Sports Science and Medicine, 21*, 1–12. https://doi.org/10.52082/jssm.2022.1

Zehsaz, F., Azarbaijani, M. A., Farhangimaleki, N., & Tiidus, P. (2011). Effect of tapering period on plasma hormone concentration, mood state, and performance of elite male cyclists. *European Journal of Sport Science, 11*(3), 183–190. https://doi.org/10.1080/17461391.2010.499976

Zhang, B., Liu, W., Lemon, S. C., Barton, B. A., Fischer, M. A., Lawrence, C., Rahn, E. J., Danila, M. I., Saag, K. G., Harris, P. A., & Allison, J. J. (2020). Design, analysis, power, and sample size calculation for three-phase interrupted time series analysis in evaluation of health policy interventions. *Journal of Evaluation in Clinical Practice, 26*(3), 826–841. https://doi.org/10.1111/jep.13266