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Comparing Training Load and Intensity Perceptions between Female Distance Runners and Their Coach

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Abstract

Coaches are trusted to create effective training plans based on the abilities of their athletes. However, there can exist a discrepancy between the coaches' intended training intensity and the intensity perceived by their athletes. Thus, the purpose of this study was to evaluate athletes' perceptions of training intensity and how they compared to their coach's intended training intensity. Six female collegiate track and field athletes who ran >800 meter events were recruited for this study (Mean [SD]: 21.3 [1.2] years). Training duration, rate of perceived exertion (RPE), average heart rate for each training session and hours slept nightly were recorded for the next 14 weeks. Easy training days showed a discernible difference with actual session RPE rating higher than the target value (mean [SD] perception 3.25 [.847], target 1.51 [.692], p<.001), while hard training days were perceived as easier than intended (mean [SD] perception 6.26 [1.24], target 8.16 [.646], p<.001). Similarly, average training load (defined as the product of Session RPE and exercise duration) was higher than coach's intentions on easy days (actual load mean [SD] 117.28 [19.15] p=.046), and lower than the coach's intentions on hard days (p=.029). Workouts that are more intense than intended may lead to overtraining syndrome in athletes, and workouts that are less intense than intended may lead to undertraining, and athletes not achieving their full potential. Appropriate monitoring of training load can provide important information to athletes and coaches. Training load needs to be accurately determined to establish other recovery factors.

Introduction

Modern sports medicine is built upon the ability of coaches to create training plans that maximize athletic performance gains while preventing injury. Despite this, overtraining injuries are still common among competitive athletes[1,2]. It is possible one of the main causes of overtraining injuries are athletes' and coaches' differing perceptions of workouts[2]. However, undertraining can also become an issue if the coach's perceptions differ from those of their athletes; prescribing training regimens that are believed to be of a greater intensity than the athletes perceive them to be won't allow athletes to maximize their athletic potential. Thus, it is important that multiple factors interact properly in order to design an appropriate training program: coaches' understanding of their athletes, the intentions of their exercises prescribed, and the athletes' perceptions while engaged in these workouts. It is important for a coach's intentions and athletes' perceptions to match to improve athletic performance, prevent injury, and reduce risk for undertraining/overtraining syndrome[3,4].

Several studies have found that perceptions often do not match, suggesting that athletes (such as soccer players[4], swimmers[9], and runners[11]) perceive easy workouts as more difficult than intended, and challenging workouts as easier than intended, specifically in intensity, duration, and load[2,4,9,11]. To this point, it is unclear how moderate intensity workouts are perceived by athletes, as studies show a mix of results. Brink et al[4]. suggests athletes (specifically elite-standard soccer players under the age of 19) perceive moderate workouts as more difficult than intended, Foster et al[2]. shows no difference between athlete perceptions and coach intentions regarding moderate workouts, and Links et al[11]. concluded athletes perceive moderate workouts as easier than coach intentions. This inequity in perception can not only lead to musculoskeletal injury[1,2]. but can also hinder the athletes' performance potential[3,12,13]. Hindered performance is based on the degree of injury, with some injuries leading to minor physical deficiencies while others could lead to loss of entire seasons[1,2]. This could result from differences between athlete perceptions and coaching intentions[11]. Identified in past studies, peak athletic performance can be best achieved when athlete perceptions match coaching intentions during training[3].

In addition, different athletes will have different perceptions of the difficulty level of a workout[2]. As discussed in the applications of Links et al[11]. the psychology and physiology of athletes contributes to the differences between perceptions and coach intentions, suggesting coaches will not be able to perfectly match intended workout intensity, duration, and load without first understanding their athletes' psychological perceptions and physical ability. In order to address this issue, research shows overtraining can be prevented and peak performance can be reached through appropriate coaching methods and workout structuring, with attempts being made to create quantitative coaching models to enhance training programs, lower the risk of overtraining, and unify athlete and coach perception of work load[14].

To the authors' knowledge, few studies have observed comparisons of coaches' intentions and athletes' perceptions in distance runners[15], choosing instead to focus on other sports, such as volleyball programs[16,17] and swimming programs[9,12]. As the demands and training programs differ between sports, it is possible that discrepancies of coaches' intentions and athletes' perceptions are sport-specific.

This study expanded on previous research performed by Links et al[11]. that analyzed the same methodology and research goals. The purpose of this study was to compare coaching intention and athlete perception of training intensity in female Division I collegiate distance runners. The researchers hypothesize that these athletes will perceive "easy" workouts as more difficult than intended, and "hard" workouts as easier than intended. Researchers also hypothesize that athletes will perceive moderate intensity workouts to be easier than intended, aligning with prior research performed by the authors[11].

Materials and Methods

Participants

An observational longitudinal research design was utilized for this study. Data collection occurred over a 14-week period in which data was collected from six participants. The participants were moderately trained female Division I athletes over the age of 18 (21.3 ± 1.2 years) from the same track and field program, and their coach. All six subjects were on the same eight-member cross-country team, on which two members were excluded from the study due to sustained injuries. All subjects participated in distance events greater than 800 meters during competition. The coach was a full-time track and field coach that held a USATF Level II certification and a master's degree. Participants were informed of the objectives, possible risks, and benefits of the study and provided written informed consent prior to participation. This study was approved by the appropriate institutional review board.

Experimental Procedures

During the initial data collection (baseline) session a custom six stage treadmill test was conducted to establish heart rate (HR) in each of the five intensity zones used to monitor training of endurance athletes (Table 1)[18]. The sixth stage was the individual runner's average 5k pace from the previous season. Participant speed (meters/min), HR and rating of perceived exertion (RPE) was collected after each stage. With each stage lasting five minutes, an increment of 10 meters/min was used to establish each workload for stages 1-5.

The coach identified the intended RPE utilizing the modified Borg Scale (Table 2) and the planned duration (minutes) of training prior to each session for a total of 81 sessions. After each training session, the runners evaluated the duration of the session and their self-identified session RPE. Runners were asked to rate their perceived exertion after approximately 30 minutes, to prevent exercises at the end of the training session from dominating their overall rating. The coach also collected average HR during each

Table 1: Simplified Five Stage Intensity Scale from Seiler & Tonnessen, 2009

Intensity Zone	% Heart Rate Max	% VO2 Max
1	55-75	45-65
2	75-85	66-80
3	85-90	81-87
4	90-95	88-93
5	95-100	94-100

Table 2: Modified CR-10 Scale from Foster et al., 2001b

RATING	DESCRIPTOR
0	Rest
1	Very, very easy
2	Easy
3	Moderate
4	Somewhat hard
5	Hard
6	
7	Very hard
8	
9	
10	Maximal

individual session through Polar Vantage XL (Polar CIC, Port Washington, NY, USA) HR monitors. An estimated maximum heart rate was then calculated based on participants' age and utilized to calculate percentage of heart rate max during data processing. This information was used to compare intended versus perceived exertion and duration. Participant average HR was also used to calculate time spent in each of the five intensity zones. This monitoring was repeated at the midpoint of the season. Data was collected from the coach and athletes each week. Small incentive prizes with an average value of less than $10 were made available to athletes that completed their training logs on time.

Intensity Determination

Participants were familiarized with the CR-10 Borg RPE scale that was used to determine the load intensity of the training session. The RPE method uses a simple question: "How hard was your workout?" Participants selected a descriptor and a number from 0 to 10, 30 minutes after the end of the training session. This was determined to be the training intensity for each session. Training load (a unitless variable) was calculated as the product of RPE and total session duration in minutes. The planned load-intensity classification of the coach was rated before the beginning of each training session. The coach intended for there to be 37 easy sessions, seven moderate sessions, and 37 hard sessions.

Foster and colleagues[5,6] developed this method of assessing an individual's interpretation of a session's intensity by modifying the perceived exertion scale developed by Borg et al[7]. Foster and colleagues utilized this scale by asking participants to rate their perceived exertion throughout the entire training session (called session RPE), and then multiplied that number by the total duration of the session to determine the training load underwent by participants. This measure has been found to be valid by several studies[8,9,10].

Statistical Analysis

Descriptive statistics and correlations were calculated using IBM SPSS statistics 23.0. Means and standard deviations were calculated for each athlete where appropriate. Normality was ensured through standard visual inspection and a normality test (Shapiro-Wilk). One-way repeated measure ANOVAs were performed to check for differences between the runners' and the coach's RPE, runners' and coach's training duration, runners' and coach's training load, and coach-intended versus athlete percentage of max heart rate. Significance level was set at α=.05.

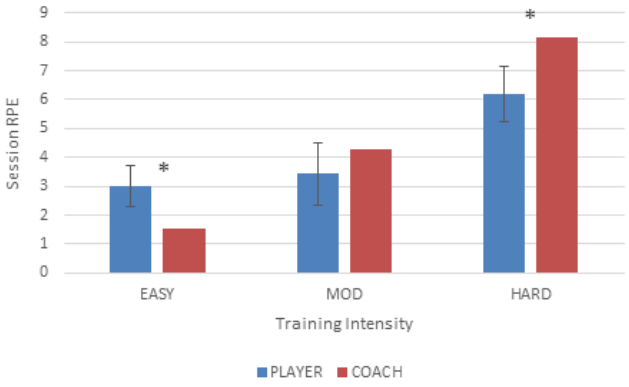
Results

The coach's perceptions of easy days were significantly lower than the perceptions of their athletes (1.51 vs 3.25 [.85], p<.001), while the coach's perceptions of hard days were significantly higher than the perceptions of the athletes (8.16 vs 6.26 [1.24], p<.001). When it came to moderate days, there was no significant difference between the coach's and athletes' perceived intensities (4.29 vs 4.10 [.95], p=.646).

There was no significant differences found between coach intended and actual training duration on easy, moderate, or hard training days (Easy: 41.5 vs 39.7 [4.0] min; Mod: 38.5 vs 32.1 [4.0] min; Hard: 36.7 vs 27.1 [6.0] min, all p>.05).

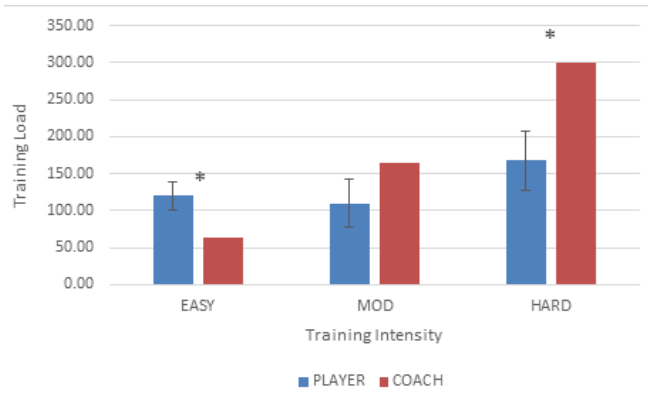
Training load was higher for athletes compared to the coach's intentions on easy days (117.28 [19.16] vs 62.83, p=.046), and lower for athletes compared to the coach's intentions on hard days (166.29 [40.57] vs 299.55, p=.029). There was no significant difference between coach's intended training load and the training load underwent by athletes on moderate training days (109.68 [31.91] vs 165.30, p=.168).

Researchers observed no significant difference between coach-intended percentage of HRmax and those recorded from athletes on easy days (73.7 vs 76.3 [4.99] %HRmax,



** indicates significant difference from coaching intentions at p<.001; "MOD" stands for "Moderate Intensity"*

Figure 1: Mean Session RPE of Players and Coach



**Indicates significant difference at p<.05; "MOD" stands for "Moderate Intensity"*

Figure 2: Mean Training Load of Players and Coach

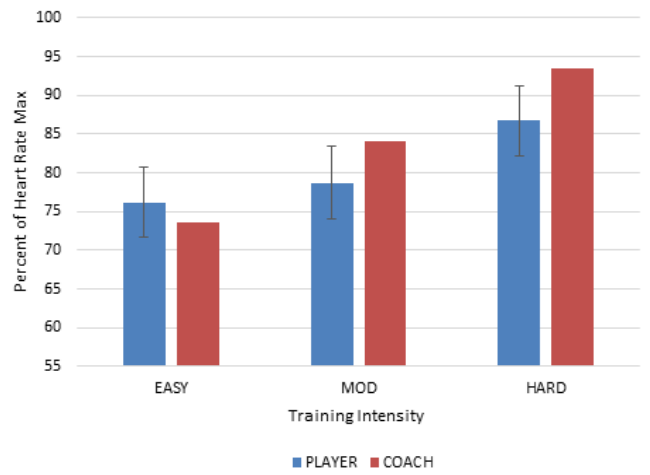


Chart lines start at 55% to align with the minimum value of Zone 1; "MOD" stands for "Moderate Intensity"

Figure 3: Percent of Estimated Heart Rate Max

p=.644), moderate days (84.1 vs 78.8 [4.75] %HRmax, p=.350) or hard days (93.5 vs 86.9 [4.51] %HRmax, p=.229).

Discussion

The purpose of this study was to evaluate the training regimen of a track and field coach while quantifying perceived training intensity in female Division I collegiate distance runners and their coach. There were two hypotheses for this study. The first hypothesis was that athletes would perceive "easy" training days as more difficult than intended, and "hard" training days as easier than intended. This hypothesis was supported. For easy and hard days, athlete and coach perceptions differed by almost 2 points on the modified CR-10 scale (difference of 1.74 on easy days, and 1.90 on hard days).

The second hypothesis, that athletes would perceive moderate intensity training days as easier than intended, was not supported. In the present study, researchers observed no significant difference between athlete perception and coach intention on moderate intensity training days.

The differences in session RPE perceptions found in the present study aligned with those found in previous literature[2,4,9,11]. Easy sessions, as determined by the coach, were found to be more difficult by the athletes' perceptions, and harder sessions as determined by the coach were found to be easier, according to athlete perceptions. Differences in perception of moderate-intensity sessions were found to be no different between the coach and their athletes, aligning with the study performed by Foster and colleagues[2]. These findings support previous literature discussing differences in coach-athlete perceptions, and provide further evidence for how coaches and athletes perceive moderate-intensity workouts, suggesting that coaches need to realign the intentions of their workouts to better match the perceptions of their athletes based on athletic level.

Regarding training load, the results follow a similar trend to the session RPE values, in that training load was almost twice as high than intended on easy days, moderate days were not found to be statistically different, and hard days were almost half as strenuous as intended by the coach. When examined more closely, it was found that the perceived intensity of the session is what led to this difference, as session-RPE was significantly different, while duration did not differ significantly between the athletes and their coach. This further supports the notion that coaches need to be more aware of the abilities of their athletes. Prescribing what they believe to be a difficult workout only for their athletes to undergo approximately half of the intended load could mean the athletes aren't achieving their full potential. By the same token, pushing athletes harder than intended on what are intended to be easy days could lead to burnout in future practices, and risks overtraining.

Interestingly though, while researchers found differences in session RPE and training load between athletes and their coach, no significant differences were found in percentage of HRmax between coaching intention and what was recorded from athletes during any of the types of training days. The authors believe there could be two explanations for this result. One hypothesis is that a small sample size will cause large differences to be more evident, reducing the statistical power. Another hypothesis, acting almost contrary to the previous hypothesis, is that as more participants are added to a study, more variance is introduced. In the present study, researchers observed a range in aerobic capacity of the athletes (Range: Easy [67.2-82.2%HRmax], Moderate [72.1-85.7%HRmax], Hard [80.9-92.1%HRmax]).

Appropriate monitoring of training intensity can provide important information to athletes and coaches. The overall

application of this research will assist coaches of distance runners implement training and workout strategies better related to the perceptions of the athletes, while also allowing them to better understand the perceptions of their distance athletes when creating workout programs. By utilizing the information of perceived difficulty versus intended difficulty, training loads are adjusted at various times during the training cycle to either increase or decrease fatigue depending on the phase of training. In regard to perceived workouts, coaches can better adjust their expectations based upon the individual level of their athletes. For example, coaches can better balance their training programs using the perceptions of their athletes to tailor the overall training plan to prevent burn out among athletes after too many perceived difficult workouts. Thus, alternative methods for prescribing training to a group of athletes aiming at the same internal load might be more appropriate, such as those based on the estimation-production paradigm (e.g. a set of exercise test procedures designed to assess the validity of using RPE to prescribe and self-regulate exercise intensity). This suggestion should be investigated and could alter how endurance training is prescribed.

There has been past debate about the usage of RPE as a standalone measure for exercise intensity. Studies have found a high degree of correlation between %HRmax and session-RPE as an indicator of training intensity, and this has led to one of two arguments. On one hand, it is argued that as %HRmax and session-RPE have a high degree of correlation, session-RPE could be used in lieu of %HRmax if needed (Foster et al., 2001). On the other hand, people have suggested that session-RPE should not be used as a standalone measure, due to the aforementioned discrepancies between coach intentions and athlete perceptions. Rather, it is argued that %HRmax and session-RPE should be used simultaneously in order to better quantify training intensity (Haddad et al., 2017). As the present study found similar discrepancies between coach's intentions and athlete perceptions, it supports the idea that session-RPE should be used in tandem with other measures to better quantify training load.

In the present study, a population of all female athletes was used. This study expands upon the current literature in which studies of female-only athletes appear sparse. Previous studies have either observed males only (Nogueira et al., 2014), or males and females (Barnes, 2017). While co-ed studies have found no difference between how males and females perceive training intensity compared to their coach, the literature pool must be expanded in order to make better comparisons.

Based on the information from the RPE of easy days, coaches can implement better strategies of recovery on easy days to assist athletes in recovery from perceived difficult days in comparison to coach intentions. Similarly, coaches can use hard day RPEs to better combat overtraining syndrome using appropriate cool down and recovery strategies. Lastly, the research shows poor correlations between the perceptions of athletes and the intentions of coaches. This could cause misunderstanding of workout strategies leading to lack of peak performance or approaching overtraining syndrome. Monitoring training can aid in enhancing the clarity and confidence regarding potential reasons for changes in performance and minimizing the degree of uncertainty associated with the changes. Coaches can adjust their expectations of workouts based on data. From these data, it is not only possible to retrospectively examine load–performance relationships, but also to enable appropriate planning for training loads and future competitions.

Training load and intensity needs to be accurately determined and monitored to establish other recovery factors.

Limitations

There are a few limitations to our study. First, the small sample size makes it difficult to generalize our results to larger populations. Similar studies have had at least 12 participants, if not more, so future studies should look at this population with additional participants. Something that could also be considered a limitation is the fact that the intentions of only one coach were observed, as opposed to other studies who have had at least two coaches reporting intended difficulties. However, this is also a reality of a smaller sport, in that it becomes more difficult for a coach to generalize training intensity to a larger group of athletes, so it places even more importance on the coach's ability to understand their athletes.

There also exists a potential limitation with how intention vs perception was measured. The coach recorded their intended difficulty prior to the session, while athletes were asked following the session. It is possible that factors outside the coach's control could have influenced the difficulty of the practice. Future studies should record both the coach's intentions before the session and their perceptions after the session in order to record a more accurate measurement.

Conclusions

This study determined that among a small sample of collegiate distance runners and their coach, workouts intended to be easy by the coach were found to be more difficult according to the athletes, and workouts intended to be difficult by the coach were found to be easier according to the athletes. This discrepancy has the potential to lead to undertraining or overtraining syndrome, so coaches should be more aware of the physical capabilities of their athletes, and adjust training intensities accordingly. There

was no significant difference in the perception of moderate intensity workouts between the two groups.

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Conflict of Interest

The authors have no conflicts of interest to declare.

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