HAAGA-HELIA
University of Applied Sciences

Monitoring Training Loads in Ice Hockey

Mikhael Horowitz

Bachelor's Thesis
Degree Program in Sports and
Leisure Management
2014

Author Mikhael Horowitz	**Group or year of entry** DPX
Title of report Monitoring Training Loads in Ice Hockey	**Number of pages and appendices** 49+11
Teacher/s or supervisor/s Mika Vahalummukka	

Historically, the ability of coaches to prescribe training to achieve optimal athletic performance can be attributed to many years of personal experience. A more modern approach is to adopt scientific methods in the development of optimal training programs, however modern methods have yet to be adopted in ice hockey. Currently, session Rating of Perceived Exertion (sRPE) is the sole method validated to be able to quantify TL in the team sport setting, and thus it can be applied in ice hockey.

The study applied sRPE in ice hockey aiming to (1) investigate to what degree of accuracy the participating collegian ice hockey team's coaching staffs were able to implement pre-planned periodized schedules; and (2) to investigate loading patterns of individuals and segments constructing the team.

Firstly, sRPE was introduced by mean of presenting research data validating the use of this method in sports similar to ice hockey. Secondly, training loads encountered by 19 women, collegian, USA Division 1 ice hockey players were measured using sRPE and an analyses of loads distribution and training implementations was performed.

Results demonstrated significant differences between the coaches intended periodized training program and the program experienced by the players. Additionally, segmenting the team revealed meaningfully different load distributions between positions and between players of different experience level. Finally, each player experienced significantly different loading patterns as well.

The article confirms sRPE to be a valuable tool in ice hockey and load monitoring to be more accurate when the team is segmented to groups and as individual players.

Keywords
Ice Hockey, Monitoring Training Loads, sRPE

Table of contents

1 Introduction

The never ending search after THE optimal training regime has brought the relationship between training and performance into focus in the minds of both coaches and sport scientists. “Models attempting to quantify the relationship between training and performance have been proposed, many of which consider the athlete as a system in which the training load is the input and performance the system output. Although attractive in concept, the accuracy of these theoretical models has proven poor.” (Borresen & Lambert 2009, 780.) While a model has yet to be agreed upon, it is broadly accepted that the ability to quantify training stimuli is essential, as the ability to plan and monitor training allows the coach to modulate training stressors and better manage fatigue which ultimately leads to greater potential (Haff 2010, 31).

A common practice of structuring training variables with the purpose of optimizing adaptations and enhancing performance is called ‘periodization’. As noted by Gamble (2012, 157): “Periodization offers a framework for manipulating training prescription to provide planned and systematic variation in training parameters (Brown and Greenwood, 2005; Plinsk and Stone, 2003; Rhea et al., 2002). In addition to avoiding potential negative effects of training monotony, this approach also affords the coach the means to progressively direct training adaptations over successive training cycles to specific training outcomes. Finally, periodization provides the facility to integrate multiple training components into the planning and scheduling of the training year.” Historically, the ability of coaches to prescribe and monitor the fore mentioned ‘training components’ depended solely on their experience and intuition. However, a more modern approach is to adopt scientific measures in the development of optimal training programming (Borresen & Lambert 2009, 779).

Modern day attempts at producing practical means enabling the quantification of various training components have evolved to a point where we are currently able to quantifying a training session into a unit ‘dose’ of physical effort, named the Training IMPulse (TRIMP) (Borresen & Lambert 2009, 786). Method of calculating TRIMP are many, and rely on either measures of HR (Castagna, Chamari, Chaouachi, D’Ottavio, Implellizzeri & Manzi 2010, 1405; Alexiou and Coutts 2008, 324), Global Positioning

Systems (GPS) (Lambert & Borresen 2010, 409), total weight lifted (Haff 2010, 31-40) or perception of exertion (Foster 1996, 370-374), to mention a few.

Although utilizing periodized programming in team sports is not a new concept, professionals have just recently attempted to apply TRIMP methods of quantifying TLs in the team sport setting (earliest research found was Dodge et al. 2001, 109-115). Although periodization is advocated by governing bodies in the sport of ice hockey (USA Hockey – Athlete Development Model, Learn to Compete stage; Hockey Canada – Long Term Player Development Model, Train to Win Stage) and quantifying training throughout the training program has been found essential, none of the possible methods of quantifying training loads, including sRPE, have yet to be validated or suggested for use in ice hockey.

Validation of a mean of quantifying TLs in a sport allows training load patterns to be investigated and conclusion to be drawn upon the effectiveness of training, individual athletes' responses to training and the implementation of training regimes (Coutts, Slattery and Wallace, Monitoring Training Loads). It is the author's opinion that the inclusion of TL monitoring in ice hockey will lead to advances in training protocols, allowing coaches to better train and prepare their athletes and team for competition.

Thus, the following article will introduce the reader to research discussing various means of quantifying exercise and to research validating the use of sRPE in team sports, claiming sRPE is currently the sole mean suitable for quantifying and monitoring training loads in ice hockey. After establishing the use of sRPE in the sport, the article will demonstrate research conducted applying sRPE as a means of quantifying training loads during the competition phase of a collegiate ice hockey team. Both methods and findings should interest ice hockey professionals as they have various practical and meaningful applications.

2 Basic Training Variables

The goal of any coaching staff is to produce a winning team or personal best performance at a specific time. Traditionally, the prescription of the training required to achieve this goal has been largely intuitive and based on experience (Barresen & Lambert 2009, 780). Currently, it is believed that the ability to quantify both training and performance will lead to advancements in the understanding of the relationship between the two (Taha and Thomas 2003, 1061). The crucial training stimuli imposed during activity is named the Training Load (TL) (Coutts, Wallace & Slattery, Monitoring Training Loads).

2.1 Training Load

Typically, TLs have been subdivided into 4 categories: internal vs. external TLs (Murphy 2013, 96 -102) and objective vs. subjective TLs (Borresen & Lambert 2008, 16-30). External TL is defined as "the work performed by athletes in both training and competition independent of internal responses to a stimulus." (Coutts, Wallace & Stattery 2009, 33-38 in Murphy 2013, 97.) Whereas, "Internal TL refers to how an athlete individually responds to the external load demands of a session." (Borg 1988 in Murphy 2013, 99.) Objective TLs are TLs independent of personal feelings or opinion, whereas Subjective TLs are dependent on personal feeling or opinion. In literature regarding weight lifting the training stimuli has been typically referred to as Volume Load (VL). Essentially, both TL and VL reflect the same concept as both are calculated according to Equation 1. (Haff 2010, 40; Kilgore & Rippetoe 2006, 55.) Henceforth, TL will be used to describe both terms.

Coutts, Wallace & Slattery (Monitoring Training Loads) demonstrate that the process of utilizing the quantification of TLs should be twofold: planned TLs should be determined pre-practice, followed by TLs being monitored after practice. Carrying out both steps allows the coach to compare intended TLs with actual TLs performed by his athletes.

The calculation of TL is expressed by the following formula:

- Equation 1. Training load = training volume x training intensity (Coutts, Wallace & Slattery, Monitoring Training Loads.)

Hence, in order to manipulate TL one must alter the training Volume (V) and/or the training Intensity (I).

2.2 Training Volume

Training Volume is representative of the amount of work done and is normally measured objectively by quantifying external loads. Measurements include total duration of training, distance covered (Coutts, Wallace & Slattery, Monitoring Training Loads) or total amount of repetitions complete in weight training (Haff 2010, 40).

2.3 Training Intensity

Training Intensity represents how hard the athlete is working and can be monitored either objectively, subjectively, externally or internally. Common measurements include heart rate, oxygen consumption and blood lactate concentration (objective, internal measurement) questionnaires, athletes' rating of perception of exertion (RPE) (subjective, internal measurement) power output (Borresen & Lambert 2009, 781-783), percentage of 1 repetition maximum (%1RM) and average weight lifted (Haff 2010, 35) (objective, external measures).

The description of the various mean of quantifying TL, Volume and Intensity are beyond this article; however a review of methods applied in the team sports setting is provided in chapter 4 with the goal of establishing a method suitable for ice hockey.

3 Physiological Demands of Ice Hockey

Methods of monitoring training should differ between various types of activities and suit the characteristics of the activity they are quantifying (Lambert & Borresen 2010, 409). Hence, defining the physiological characteristics of ice hockey must proceed deciding on a proper method of computing TLs in the sport. Consequently, the following chapter will outline the basic characteristics of the sport. The findings of this chapter will serve as a major consideration in the process of evaluating monitoring techniques for the sport of ice hockey.

3.2 The Game

Ice hockey is a start and stop, one-on-one, intermittent collision sport, where practice and competitive play consists of, and is characterized by, explosive dynamic movement patterns, and the technical skills of skating, shooting, passing, and body checking (Rhodes & Twist 1993a, 44; 1993b, 68). An international standard rink is approximately 60 meters long and 30 meters wide(International Ice Hockey Federation's (IIHF) Official Rule Book 2010-2014), while in North America a standard playing rink is 200 feet by 85 feet (National Hockey League Rule Book). Each team consists of a maximum of 6 players playing on the ice surface at the same time. Substitutions are independent of stoppage of play. Game length is 60 minutes, consisting of three 20 minute periods with a 15 minute rest interval following periods 1 and 2. The team that scores the most amount of goals is determined the winner. In case the game is tied, an additional, 5 minute, 'sudden death' (first team to score wins the game) period follows the game. If no goal is scored in the additional period, the game is to be determined in a shootout. (International Ice Hockey Federation's (IIHF) Official Rule Book 2010-2014.)

The game is played with stoppage time, meaning that when the game is stopped (for an example as a result of the puck leaving the playing surface) so is the game clock (in contrast to soccer). As a result of game clock being stopped, a typical hockey game lasts between 2 and 3 hours. (MacLean, A Theoretical Review of the Physiological

Demands of Ice-Hockey and a Full Year Periodized Sport Specific Conditioning Program for the Canadian Junior Hockey Player, 1).

3.3 Annual Schedule

Usually, a hockey schedule of practices and games occurs on nearly a daily basis and may extend 7-10 months with differences in schedules occurring between age categories and levels of competition (USA Hockey Long Term Athlete Development Model). In total, an annual schedule for a team at the U18 age category, Tier 2 level, would include ~125 total ice touches allocated as 80-85 practices and 40-50 games. Whilst at the same age, in the Tier 1 level, volume and frequency is increased to ~200 total ice touches allocated as 140-150 practices and 50-60 games.

The annual training program includes phases dedicated to preparation, phases dedicated to competition and a transition phase. Bompa & Chanbers (1999, 146-162) describe an annual training program for professional, national and university teams. They divide the training schedule into 4 phases. During each phase physical characteristics are either developed or maintained as a result of training, and a specific training medium is utilized. Accordingly, an example of an annual schedule is presented in Table 1.

Table 1. Example of an Annual Ice Hockey Schedule

Phase	Dates	Training Medium	Training goals
1. Preparatory Phase	June-August	off-ice	Development of aerobic and anaerobic endurance, flexibility, maximal strength proceeded by power.
2. Pre-Competition/Pre Season	September	on and off – ice	Development of on ice skating speed, flexibility, quickness and agility, power and power endurance
3. Competition Phase	October – April	on and off-ice	Maintenance of all physical characteristics and abilities.

Transition	May	off-ice	Development of anatomic adaptations.

3.3 Metabolic Demands

The average National League Hockey (NHL) player receives less than 16 minutes of actual playing time extended over 3 hours; however some players may receive as much as 35 minutes playing time (Cox, Miller, Rhodes & Verde 1995, 185). A major contributor to the wide variation in individual player's playing time is positional as many defensemen are on the ice for almost 50% of the game, presenting ~30 minutes, compared to an average of 35% for forwards, presenting ~21 minutes. Rhodes & Twist (1993a, 44). In agreement with Rhodes & Twist, Bishop et al.(1976, 159) concluded a range of playing time may vary between 20.7-28 minutes with defenders playing longer than forwards.

In the National Hockey League shift duration is between 30-80 seconds, averaging 45 seconds (Rhodes & Twist 1993a, 44-46 in MacLean, A Theoretical Review of the Physiological Demands of Ice-Hockey and a Full Year Periodized Sport Specific Conditioning Program for the Canadian Junior Hockey Player, 1)Typically, 2-3 interruptions occur within a shift and continuous play consists of 30 seconds (Rhodes & Twist 1993a, 45). Similar results have been found in collegian hockey, as average shift length is between 81-88 seconds, consisting of 37.5-42.5 of playing time (Bishop et al. 1976, 161)

Bracko (2004, 47-53) describes a detailed breakdown of skating patterns and intensities during a hockey shift. He analysed NHL forwards to investigate the time and frequency of 27 skating characteristics during a game. Skating characteristics were divided into 3 level of intensity: High, Medium and Low. In an attempt to classify the primary energy system being utilized during ice hockey play, the author matched each skating intensity with a contributing metabolic energy system. Matching was performed based on Earle & Thomas (1994, 74), breakdown of the effect of duration on the primary energy system used, and the breakdown of major characteristics of human energy systems described by Williams (2006, 105). Results demonstrate that an ice hockey player competes at various intensities throughout a typical shift. A majority of time is spent in medium and low intensity play (15-41% & 49-68%, respectfully) and is energized mainly by both the fast glycolysis and oxidative systems. A shorter percentage of the shift (10-15.4%) is considered highly intense and is energised mainly by the ATP-PC and fast glycolysis system (Table 2.)

Table 2. Summary of Shift Break Down According to Playing Intensity

Intensity	Total time and Percentage of shift	Primary Energy System
High Intensity	10-15.4% 4.5-6.9 seconds	ATP-PC and fast glycolysis
Medium Intensity	15-41% 6.75-18.45 seconds	Fast glycolysis and oxidative system
Low Intensity	49-68% 22.05-30.6 seconds	Oxidative system

Although both defenders and forwards experience high intensity efforts and submaximal activity during competition, defenders play more shifts, at a relatively lower pace, with less rest duration between them. Thus, their reliance on the aerobic energy system for production of energy is greater. While forwards experience more anaerobic activity during games, both positions average blood lactate measure during games are the same (8.7 mmol/L). Lactate accumulation is similar between positions even though defenders' play is less intensive as a result of the shorter rest time they experience between shift. (Rhodes & Twist 1993a, 44-45.)

The goaltender position is unique as typically only one goaltender plays the entire duration of the game. "The goaltender position is characterized by rapid, explosive, repetitive movement, drawing in large part the ATP-PC system (making a save, clearing the puck). The lactic acid system (glycolysis) may, at times, also be important for the goaltender, when forced into the ready position for long periods of time and when required to make numerous save within a short period of time." (Rhodes & Twist 1993a, 44.)

3.4 Physical Characteristics of Ice Hockey Players

The demands of the sport require ice hockey players to have relatively highly developed aerobic and anaerobic capacities, upper and lower body strength, power, agility and flexibility (Rhodes & Twist 1993b, 69-70). Physical testing typically includes a measure of all or a portion of those abilities. Physical profiles of National Hockey League Players in 1993 (Attachment 1.) reveals defenders and forwards to have similar characteristics in strength values, anthropometry, and flexibility; with a more noticeable difference in V02max values (57.4 and 54.8 (ml/kg/min) for forwards and defenders, respectfully) (Rhodes & Twist 1993a, 45). However, much advancement has been made in training since 1993. Hence, a more up to date analysis of the absolute elite ice hockey players' physical qualities was attained by gathering the top 10 test results of the 2012 NHL entry draft (National Hockey League Central Scouting Results. URL: http://centralscouting.nhl.com/link3/cs/public-home.nsf/page?readform&app=combine.) (Table 3.). Unfortunately results were not segmented by position.

Table 3. Range of Top 10 Results of 2012 NHL Draft Tests

Test	Score	Test	Score
Body Fat	6.8-7.5%	Standing Long Jump	112-119.3 (inches)
Grip Strength – right hand	144-177 (lb.)	Vertical Jump	29-30.5 (inches)
Grip Strength – left hand	142-162 (lb.)	Hand Eye Coordination	22.4-25.5
Upper Body Push Strength	279-366 (lb.)	Wingate Test - Peak Power Output (watts/kg)	15-15.9
Upper Body Pull Strength	281-323 (lb.)	Wingate Test - Mean Power Output (watts/kg)	11-11.9
Bench press reps (150 lbs.)	11-13	Wingate Test – fatigue index	33.7-39.5
Curl Ups	46-70	VO2max (ml/kg/min)	68.7-63.6

Push Ups	33-45	VO2max test duration (min)	12:06-14:00
Seated Medicine Ball Throw (4kg)	217-248 (inches)		

4 Monitoring Training Loads in Team Sports

The characteristics of the sport being monitored are not the lone consideration in choosing an appropriate method for quantifying a sport. It is equally essential to choose a method that can be applied to all modalities of training (e.g. strength, speed, endurance and technical/tactical training) and to competition so that all training stimuli are accounted for (Decker, Desgorces, Garcia, Noirez & Senegas 2007, 763). Hence, prior to evaluating which method suits ice hockey, methods that can be applied to all types of training partaken by team sport athletes must be determined.

4.1 Measures of Total Weight Lifted

When working with a large group of athletes Haff (2010, 32) suggests that the strength and conditioning coach use the following equation to quantify TL in weight lifting:

- Equation 2. Volume Load = number of sets X number of repetitions X %1RM

Where 1RM = maximal weight lifted in one repetition

Although summating amount of weight lifted is a common method of quantifying and monitoring TLs used by professional weight lifters, it is not a method which can be transferred to other domains of hockey training. For example, it would not be possible to use when attempting to estimate the VL encountered by a player during plyometric training, anaerobic speed endurance training, sprint training, training on the ice or during a game. Thus it can be concluded that this method cannot be applied to quantify the various TLs encountered during all modalities of team sport training.

4.2 Heart Rate Measures

Two HR-based methods – Banisters' TRIMP and Edwards' TRIMP are considered gold standards when assessing TLs (Castagna et al. 2010, 1405).

The first method, named Banisters' Training Impulse (Banister's TRIMP), originally introduced by Bach, Banister, Calver & Savage (1975, 57-61, in Alexiou & Coutts

2008, 323-324; Clark, Scott, Janse de Jonge, Knight & Lockie 2013, 197) uses the following equations to obtain a single numeric score to quantify the TL of a training session:

- Equation 3. Banisters' TRIMP =D(ΔHR ratio)eb(ΔHR ratio)

Where D = duration of training session in minutes and b = 1.67 for females and 1.92 for males.
ΔHR ratio = (HRex − HRrest) / (HRmax − HRrest)
where HRrest = the average heart rate during rest and HRex = the average HR during exercise.

The second method – Edwards' TRIMP or The HR-Zone Mehtod, originally introduced by Edwards (1993, 113-123, in Decker, Desgorces, Garcia, Noirez & Senegas 2007, 765; Clark et al. 2013, 197), calculated the product of the cumulated training duration (in minutes) for 5 HR zones multiplied by a coefficient relative to each zone (i.e., 50%–60% HRmax = 1; 60%–70% HRmax = 2; 70%–80% HRmax = 3; 80%–90% HRmax = 4; 90%–100% HRmax = 5).

- Equation 4. Edwards' TRIMP = duration in zone 1X1 + duration in zone 2X2 + duration in zone 3X3 + duration in zone 4X4 + duration in zone 5X5

A third HR-based method, used by Alexiou and Coutts (2008, 324) is named LTzone. This method has been less stated and evaluated in the scientific literature and is based on dividing HR into zones using the Lactate Threshold (LT) and Anaerobic Threshold (AT) as markers. Quantifying TLs using this method involves multiplying the time spent in three heart rate zones (zone 1: below LT, zone 2: between LT and the AT; and zone 3: above AT), by a coefficient relative to each intensity zone (k = 1 for zone 1, k = 2 for zone 2, and k = 3 for zone 3) and summating the results (Equation 5.).

- Equation 5. LTzone = duration in zone 1X1 + duration in zone 2X2 + duration in zone 3X3

Although HR-based methods have been used to quantify different modules of training, HR methods of monitoring training have been considered a relatively poor method of evaluating high intensity exercise such high intensity interval training and plyometric training because these types of exercises depend on a large contribution from oxygen-independent metabolism rather than oxygen-dependent mechanisms (Alexiou & Coutts 2008, 328). Furthermore, they have been found completely unable to quantify TL during strength training because heart increases disproportionally during resistance exercise (Borresen & Lambert 2009, 785). In conclusion, HR-based methods are an important contributing tool assisting in quantification of TLs; however this method cannot be applied to all modalities of training and thus cannot be the sole mean of quantifying TLs in team sports.

4.3 Blood Lactate Measures

The usage of Blood Lactate (BL) measurements has been discussed as a possible means of quantifying training intensity (Lambert & Borresen 2009; 2010) as BL accumulation variation has been suggested to correlate with specific intensities of exercise. However, inter – and intra- individual differences, as well as other factors, such as temperature of the environment, type of exercise and exercise duration limit the validity of associating a specific measurement of BL in mmol/L to specific exercise intensity. (Lambert & Borresen 2009, 782.)

Although measurements of BL have become easier with the advances of technologies which allow collection using a signal drop of blood, BL measurement remains impractical on a daily basis during training (Lambert & Borresen 2009, 782; Decker et al. 2007, 763). Moreover, to the best of the author's knowledge, the quantification of TL (TL = V X I), relying on a signal numeric number to be placed as the training intensity derived from BL has not yet been presented or examined in the scientific literature. Hence, the quantity of TL based on BL measurement is impractical in sports.

4.4 Global Positioning System Measurements (GPS)

GPS measurements offer a means to measure total distance covered and speed during training. This method has been proposed in the scientific literature as a means of quantifying TL (Lambert & Borresen 2010, 409) and the accuracy of system measurements has been tested (Aughey, Boyd, Coutts, Cormack & Jennings 2010, 328-341). Aughey et al. (2010, 328-341) analyses entitled - The Validity and Reliability of GPS Units for Measuring Distance in Team Sport Specific Running Patterns concluded current methods to be limited in their ability to accurately and reliably assess short, high speed straight line running and efforts involving change of direction, which are an important part in team sports activity.

Additionally, GPS technology is limited in its ability to measure total distance travelled in ice hockey as a result of competitions being played indoors and, it's the author's opinion, that measurements of total distance travelled is limited in predicting TLs in ice hockey as a result of players' ability to continually move without expending energy while gliding. Finally, the application of a method of quantifying TL using GPS units is limited by its inability to be used during other means of training, such as strength training or plyometric training.

4.5 Session Rating of Perceived Exertion (sRPE)

In their review of methods used to measure TL in team sports, Borresen & Lambert (2010, 406-411), presented a method, originally devised by Foster (1996, 370-374), named the session Rating of Perceived Exertion (sRPE). TL is obtained applying sRPE by asking the trainee "how was your work out?" and having him/her rate his/her perception of the difficulty of the training stimuli on a scale of 0-10 (Figure 1.). The trainee is asked to rate his relative perception of effort (RPE) at a set time after completion of the entire session, typically 30 minutes. Collection of RPE about 30 min after each training session ensures that the perceived effort referred to is for the whole session's rather than the most recent exercise intensity (Coutts, Franco, Impellizzeri, Marcora, Rampinini & Sassi 2004, 1043).The numeric value is then multiplied by duration of the session in minutes or the number of repetitions in resistance training (equation 6). (Borresen & Lambert 2010, 408; Eston 2012, 176.)

- Equation 6. TL = D/Reps X RPE

Where D = Duration in minutes, Reps = Repetitions

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

Figure 1. Example of Borg's Category-Ratio -10 (CR- 10) scale used by Brice, Foste, McGuigan & Meghan (2004, 354). Scale has been modified to reflect American English (e.g. light becomes easy). Each numeric value is assigned a specific perception of exertion on a scale beginning at "rest" and ending at "maximal".

Although repetitions is an accepted variable used in the calculation when quantifying weight training, it is typical to use duration in the calculation of sRPE during resistance training if this training is performed as an integrated part of team sport athletes' training (Alexiou and Coutts 2008, 320-330; Castagna, Chamari, K., Chaouachi, D'Ottavio, Implellizzeri and Manzi, 2010, 1-8).

Decker et al. (2007, 762-769) demonstrated a significant limitation of sRPE in its ability to quantifying different types of training. Their research concluded that specific exercise components will not have a substantial influence on TL in a given training period using sRPE. They demonstrated that for endurance sessions results of sRPE-based calculations were twice as high as those of sprint or strength TLs(238.4±60, 222.9±54.7 and 264.3±114.7, respectfully), which they consider an overestimate of physiological load induced (Decker et al. 2007, 766). For that reason, a graph presenting TLs attained using sRPE might overvalue or undervalue specific modules of the training. Although sRPE is limited, authors conclude sRPE to still be useful in measuring TLs in team sport.

Finally, and most importantly, currently sRPE is the sole method proven valid for quantifying exercise training during a wide variety of exercises types (Dodge et al. 2001, 109).

5 Validating the Use of sRPE in Ice Hockey

Typically, sRPE is validated for use in a specific sport by means of comparison of objective, internal loads (e.g. HR, lactate) or external load (e.g. total distance or weight lifted) to sRPE and proving they significantly correlate (Carlson, Jomes, McInnes & McKenna 1995, 387-397; Alexiou and Coutts 2008, 320-330; Black, Coutts, Quinn & Scott 2013, 270-276). However, procedures required to achieve such a validation were beyond the author's reach. Therefore, as an alternative mean, the author turned to review literature in search of information validating the use of sRPE in ice hockey.

Previously, Chen, Fan and Moe (2002, 873-899) conducted a meta-analysis entitled 'Criterion-related validity of the Borg ratings of perceived exertion scale in healthy individuals'. They systematically searched five databases: SPORT Discus, PSYCHLIT, ERIC, MEDLINE and PubMed, using the following key words: heart rate and perceived exertion, oxygen uptake, ventilation or respiration rate and perceived exertion, perceived work, and exercise intensity. Additionally, the reference lists of all searched articles (both empirical and review) as well as books were searched. They concluded that "Any study exploring the relationship, using Pearson's r, between ratings of perceived exertion and any of the six criterion measures was included in the meta-analysis. Thus, all articles since the inception of the Borg RPE scale (1961 to 2001) were considered for inclusion." (Chen, Fan & Moe 2002, 876.) It was the author's intent that a search through the reference list in their article would reveal articles discussing the use of sRPE in team sports, specifically ice hockey. Unfortunately, that was not the case.

As a result, an additional search of the academic literature was performed on SPORTDiscus using the following terms: 'sRPE in team sports', 'sRPE in ice hockey' 'quantifying training in team sports', 'training loads', 'external training loads', 'internal training load' and 'monitoring exercise training', limited to English paper. The search resulted in the discovery of 5 relevant articles discussing sRPE's application in various sports. References from those articles led to the recovery of 2 additional papers. In total, articles discussing application of sRPE were collected in the following sports:

soccer (n=3), Australian football (n=1), basketball (n=2) and rugby (n=1). No articles were found related to ice hockey.

Hence, it can be concluded that research data on the use of sRPE in sport is limited and research validating the usage of sRPE in ice hockey is none existent (to the best of the authors knowledge). Consequently, as a second best option, the introduction and consideration of using sRPE in ice hockey is attempted in the following article by mean of discussing data collection and analyses performed on team sports other than hockey. An important consideration when taking this approach is that in order to consider a method of monitoring TL in team sports to be appropriate, one must consider the characteristic of the specific sport being monitored (Borresen & Lambert 2010, 409). Thus, prior to reviewing a specific sport, the similarity between the sport and ice hockey was tested in regard to one or more of the following criteria – (1) they are intermittent sports which rely on a variety of energy systems for competition and recovery, (2) they are a team sport and (3) they are a collision sport.

5.1 The Use of sRPE in Australian Football

As part of their research, Black et al. (2013, 270-276) examined the relationship between TLs recorded using sRPE, HR-based methods (Edwards' & Banisters' TRIMP) and distance travelled measured using GPS units in Australian Football (AF). AF is a team sport which they characterize as both a collision sport (Black et al. 2013, 270) and intermittent sport (Black et al. 2013, 271), and thus is similar to ice hockey in those criteria.

21 AF players (ages 19.0 ± 1.8 years) were examined during a 13 week period of skill training (number of training sessions = 38). They found all correlations of TLs methods to be statistically significant ($p \leq 0.05$) with a stronger correlation between internal training loads (HR) and sRPE than external TLs (total distance travelled) and sRPE. The authors explain this difference by attributing the external load to be only one contributor to the overall load experienced by the individual, whereas the internal load takes into consideration both external load and other effects (e.g. training status, fatigue state, previous training and genetics). In contrast, the authors found a poor rela-

tionship between sRPE and HR-based methods when performing short, high speed intermittent running (3 different speeds of the Yo-YolR1 Test). Although reasoning is not given in the original article, the author attributes poor correlation between the two to limitations of HR-based methods in monitoring high intensity exercise because of their dependency on a large contribution from oxygen-independent metabolism rather than oxygen-dependent mechanism (Alexiou & Coutts 2008, 328). The authors concluded that sRPE remain a valid method to quantify TLs in high intensity, intermittent, team sport.

5.2 The Use of sRPE in Soccer

Atkinson, Drust and Reilly (2007, 783 - 784) characterize soccer as a team sport, regarded primarily as an aerobic sport that incorporates frequent fluctuations between high and low exercise intensities. During 90 minutes of play, numerous explosive bursts of activity are required, including, jumping, turning, sprinting etc. (Castagna, Chamari, Stølen & Wisløff 2005, 502). Consequently, soccer can be considered similar to hockey in the criteria of being both an intermittent and team sport.
Alexiou and Coutts (2008, 320-330) examined the relationship between TLs computed using sRPE and 3 HR- based (Banisters' TRIMP, Edwards' TRIMP and LTzone method) over a 16-week soccer season. Their study examined 15 elite women soccer players (age: 19.3 ± 2.0 years, height: 169.0 ± 5.1 cm, body mass: 64.8 ± 7.7 kg, VO2max: 50.8 ± 2.7 $mL \cdot kg{-}1 \cdot min{-}1$). All players were scholarship holders at the Football Association (FA) National Player Development Centre (Loughborough University, Loughborough, UK).

Training session examined included all typical modalities of training in soccer: technical/tactical sessions, high intensity resistance training session, aerobic conditioning session, recovery sessions and match play. Results demonstrated individual correlations between sRPE and HR based methods to be statistically significant for each of the various training modalities ($p < .01$), with a weaker correlation of measurement following match play and resistance training. They attribute the difference in correlation to a well-known stronger correlation between sRPE and HR-based methods following endurance-based, steady-state exercise rather than measures following stochastic, intermittent, or interval-based exercises, especially following strength training (Alexiou and Coutts, 2008, 328-329).

A more recent study conducted by Clark et al. (2013, 195-202) compared methods of quantifying TLs of professional soccer players (age 24.9 ± 5.4 y, body mass 77.6 ± 7.5 kg, height 181.1 ± 6.9 cm). 97 individual training sessions were quantified using both external TLs (total distance, the volume of low-speed activity [LSA; <14.4 km/h], high-speed running [HSR; >14.4 km/h], very high-speed running [VHSR; >19.8 km/h], and player load) and internal TLs (Banisters' TRIMP, Edwards' TRIMP and sRPE).

Results demonstrated that all correlations between measures of internal TL were statistical significance (P < .01), and measures of internal TL displayed statistically significant correlations (P < .01) with all measures of external TL (Clark et al., 2013, 199). Authors conclude sRPE to be a valid mean of monitoring TLs in soccer.

5.3 The Use of sRPE in Basketball

Carlson et al. (1995, 387-397) examined the intensities and movement patterns during professional men's (Australian National Basketball League) basketball games by videotaping and monitoring HR and Blood Lactate (BL) responses of eight players. Their results demonstrated:

> The mean (± S.D.) frequency of all activities was 997 ± 183, with a change in movement category every 2.0 s. A mean total of 105 ± 52 high-intensity runs (mean duration 1.7 s) was recorded for each game, resulting in one high-intensity run every 21 s during live time. Sixty percent of live time was spent engaged in low-intensity activity, while 15% was spent in high-intensity activity. (Carlson et al. 1995, 387.)

As a result of the demonstrated fluctuation between various intensities of activities in the game, basketball can be categorized as an intermittent and team sport (National Basketball Association Official Rule Book, Rule Number 3), and is similar to hockey in those criteria.

Castagna, Chamari., Chaouachi, D'Ottavio, Implellizzeri & Manzi, (2010, 1-8) monitored the TLs of 8 full-time professional (Lottomatica Virtus Basket Roma, Serie A1—

first/elite division) basketball players (age 28 ± 3.6 years, height 199 ±7.2 cm, body mass 102 ± 11.5 kg, and body fat 10.4 ± 1.5%) during 3 weeks of the season using sRPE, Banisters' and Edwards' TRIMP.

The first concern of their study was to assess the validity of the sRPE method in evaluating a variety of training types performed by professional highly competitive basketball players. "It was assumed that the mainly high-intensity demands (i.e., anaerobic domain) imposed on professional basketball players (28) could possibly alter the relationship between heart rate (HR) and RPE (24)." (Castgana et al. 2010, 2.) Modalities of training included technical/tactical training, strength training, plyometric training and matches.

Significant relationships were found between individual sRPE and both HR-based TL (r values from 0.69 to 0.85; p, 0.001), as well as between team sRPE and team Edwards' TL (r =0.85; p, 0.001; 95%CI 0.93; 0.68). Authors concluded their findings to be supportive of the notion that sRPE is a viable method to characterize training responses in players even at the professional basketball level.

An additional research performed Dodge et al. (2009, 109-115) investigated 14 collegiate men's basketball players from the same basketball team. Their age, height, weight, body fat % and VO2max (mean ± SD) were 20.2 ± 1.5, 191.4 ±4.9, 89.3 ±7.8, 12.8 ±2.8% and 4.60 ± 0.5 (L/min), respectfully. Subjects were measured during basketball practice and/or competition using Edwards' TRIMP and sRPE, and the correlation between the measurements was determined. The authors concluded that the results of the study are "consistent with our previous observations of a highly correlated relationship between the session RPE and the summated HR zone methods of evaluating training session. This suggests that either method may be used as a method of creating a TRIMP score for the evaluation of exercise training." (Dodge et al. 2001, 113.)

5.4 The Use of sRPE in Rugby

Rugby is similar to hockey as it's a team sport, intermittent in nature and includes collisions (Gabbett, Jenkins & King 2008, 120-121). Coutts, Franco, Impellizzeri, Lovell and Thomas (2013, 62-69) conducted a study with the purpose of examining the validity of sRPE for monitoring training intensity and loads in rugby league. They examined 31 professional rugby league players (24.4 ± 4.1 years, height 184.8 ± 5.3 cm, body mass 98 ± 10 kg) from the same National Rugby League (NRL) club. Data was collected during an entire season and assessed using heart-rate monitors, GPS, accelerometers and sRPE. Within-individual correlation analysis was used to determine relationships between sRPE and the other TL markers.

The authors demonstrated that:

> The main finding of the study was the significant within-individual correlations between sRPE and various other internal and external measures of intensity and load. It was also observed that a combination of internal and external TL factors predicts sRPE in rugby league training better than any individual measures alone. These results further demonstrate the validity of sRPE as an indicator of training intensity for rugby-league-specific training. (Coutts, Franco, Impellizzeri, Lovell & Thomas 2013, 66.)

In conclusion, sRPE has been validated as a mean of quantifying TLs in 7 sports and has yet to be disclaimed for use by any investigation regarding team sports. It has been found to significantly correlate to internal, objective measure (Banisters' and Edwards' TRIMP) and external measures (total distance and varying speeds using GPS, and accelerometers), and has been validated as means of qualifying different modalities of training. An additional advantage of this method is its low cost and lack of reliance on technical expertise or equipment that make it a very user friendly and practical tool for monitoring TL in sports (Alexiou & Coutts 2008, 329). Consequently, sRPE is a method that can be applied by both professional teams and by minor teams to quantify and monitor TLs. Currently, it is probable to assume sRPE is a valid mean of quantifying TLs in ice hockey; however future research should validate its use by comparing sRPE scores to objective TLs following ice hockey training and competition.

5 Research Objectives

The aims of this study were (1) to investigate to what degree of accuracy the participating collegian ice hockey team's coaching staffs were able to implement pre-planned periodized schedules; and (2) to investigate loading patterns of individuals and segments constructing the team.

The author's research questions are as follows:

1. To what degree of accuracy did the collegian ice hockey team's coaching staff implement their pre-planned periodized training program?

2. Were the loading patterns of different groups within the team segmented by position significantly different from each other, justifying quantifying training separately for each group?

3. Were the loading patterns of different groups within the team segmented by competitive experience at the collegian level significantly different from each other, justifying quantifying training separately for each group?

4. Were the loading patterns of individual players significantly different from each other, justifying quantifying training on an individual basis?

It was the author's hypotheses that investigating the implementation of the training program would reveal significant differences between the pre-planned training program and its implementation, and that different groups and individual players would experience significantly different TL patterns, justifying quantifying training separately for each group and on in individual basis.

6 Methods

6.1 Subjects

Nineteen of twenty three women ice hockey players (4 excluded as a result of injury) from the same USA division 1 university (WCHA league) ice hockey team were involved in the study. Their age, height, weight, percentage of body fat and VO2max were (mean ± SD) 20.47±1.31 years, 169.4 ± 6.3 cm, 67.63±5.63 kg, 26.06±3.68% and 47.2±3.3, respectively.

Players were observed during the in-season (3 weeks) and playoffs (1 week) segments of the training schedule during the 2013–2014 season. Players were classified according to years of experience at collegian level of competition: Freshmen (FR) (1st year students, 0 years of prior experience, n= 4), Sophomores (SO) (2nd year students, 1 year of prior experience, n=3), Juniors (JU) (3rd year students, 2 years of prior experience, n=6) and Seniors (SE) (4th year students, 3 years of prior experience, n = 6). Additionally, players were classified according to their playing position: Forwards (F, n=10), Defenders (D, n=7) and Goalies (G, n=2).

6.2 Physical Training

The training program was set by the players' coaching panel throughout the study period. A typical week of training consisted of three technical/tactical sessions on the ice, one resistance training session and two competitive matches (three competitive matches were performed during the playoff week as part of a best of three series (first team to win two games advances)). Games were performed according to the schedule outlined by the governing league –The WCHA.

Technical/tactical sessions focused on acquisition and refinement of hockey-specific skills, refinement of individual and team tactics, setting of game strategy and hockey specific conditioning. A typical session began with a warm up drill which consistent of a game or individual skill development, continued with 3-5 drills and proceeded by either a small area game or hockey specific conditioning.

Weight lifting was set by a strength and condition specialists. Resistance training focused on maintenance of high power outputs and strength gains develop during the pre- and regular season. Workouts lasted 40 minutes including a warm-up and post-lift stretch and foam roll. The exercises used consisted of various jumps (DB Squat Jumps, Box Jumps) and upper body medicine ball movements (MB Jerk, MB side to side Slams, MB Chest Pass). The lower body strength movement performed were two sets of 5 the first week, 2 sets of 5 the second week, and 2 sets of 4 the third week on Lateral squats. Posterior chain was targeted through Dumb Bell Romanian Dead Lifts (DB RDL's) with two sets of 8, two sets of 8, and two sets of 6 in the corresponding weeks. Upper body strength was trained with three sets of 4 bench presses all 3 weeks, and two sets of 10 inverted rows on TRX Suspension Trainers. Athletes upper back and neck were targeted with a set of 15 shrugs each workout. Training intensity was 72-82% of 1RM for resistance training exercises. Rest ratio was 1:6 for ballistic work, and jumping and strength movements were done in pairs with 1 player performing the exercise while the other rested (approximately 30-60 seconds rest between sets).

6.3 Measurements

An accommodation phase proceeded the data collection period. This was performed with the purpose of familiarizing players and coaches with the procedures of data collection. The accommodation phase extended 3 weeks during the in-season segment of training and consisted of 6 games, 5 weight lifting sessions and 5 on ice technical and tactical sessions.

Body composition analysis was performed using GV Healthcare's Lunar iDXA whole body scanner. Beep test was performed according to procedures described by the International Ice Hockey Federation's testing protocols at their women's U18 high performance camp, Vierumaki, 15-22 July, 2012 (Attachment 2.) and conversion of beep test results to VO2max values were performed according to procedure described by Brewer, Ramsbottom and Williams (1988, 141-144).

The sRPE method was used to both predict (prior to training) and estimate (post-training) internal TLs. Coaching staff predicted TLs by mean of multiplying training duration in minutes by their prediction of the difficulty of training on Borg's modified CR-10 Scale (Figure 1.) Match TLs were predicted by placing the average duration and average exertion rating demonstrated by the team following games during the accommodation period. The duration and RPE (mean ± SD) of the 6 matches performed during the accommodation period was 129± 14 and 6.6 ±0.6, respectfully, resulting in a TL of 847.1.2±134.4 (Table 4.).

Table 4. Game TLs during Accommodation Period

Game	Date	Duration (min)	Mean Team RPE	sRPE
1	10-Jan	123	7.7	947.1
2	11-Jan	155	6.9	1069.5
3	24-Jan	133	6.1	811.3
4	25-Jan	124	6.5	806
5	31-Jan	120	6.1	732
6	1-Feb	119	6.1	725.9
Average		129	6.6	847.1
Stand Dev		14	0.6	134.4

Post-training and post-game TLs were estimated by multiplying the average RPE score provided by the players by training duration (Equation 8). Training duration of practice began when coaches began practice by assembling the team for instructions, and ended when the coaches assembled the team to give their remarks of conclusion, and was recorded in minutes. RPE scores were reported by the players by means of text messaging, at least 30 minutes after the conclusion of training. Numeric values reported via text messages were gathered by a leading player on the team and reported to the coaching staff (Attachment 3).

Perception of exertion and session TLs were recorder for each player, the team as a whole, and segmented by groups according to playing experience in the collegian level and according to position (Attachments 3-6). For goaltenders, postgame RPE was recorded for the playing goaltender only (no substitution of goaltenders was performed during games).

Calculations, adapted based on methods used by McGuigan (2004, 42-47), were:

Predicted (pre-training) TL (PTL) was calculated:

- Equation 7. PTL = PRPE X D

Where PRPE is Predicted RPE and D is duration in minutes

Actual Training Loads (ATL) was calculated:

- Equation 8. ATL = AVGRPE X D

Where AVGRPE is team Average RPE and D is duration in minutes

Daily TL (DTL) was calculated:

- Equation 9. DTL = S1TL+S2TL

Where S1TL and S2TL are Session1 TL & Session2 TL, respectfully.

Weekly TL (WTL) was calculated:

- Equation 10. WTL = D1TL+D2TL+D3TL+D4TL+D5TL+D6TL+D7TL

Where D1-7TL is TL of day1 to day7 of the week, respectfully.

Monthly TL (MTL) was calculated:

- Equation 11. MTL = W1TL+W2TL+W3TL+W4TL

Where W1-4TL are TL of week1 to week4, respectfully.

Average TL per session for each individual player was calculated:

- Equation 12. AVG session TL = Total of all sessions TLs/number of session performed

6.4 Statistical Analysis

The sums of daily, weekly and monthly training loads were added to establish total TLs during that period. Team and groups TLs were added to establish total TLs per segment of the team. Each individual athlete's TLs were analysed by adding TLs and averaging (mean ± SD) TLs.

The fluctuation between daily, weekly and monthly TLs were analysed by means of comparison of values (comparison of one daily value to another and one weekly value to another) to determine if their relation was equal, or if one was greater/lesser than the other (=, > or <).

7 Results

A total of 19 out of 23 players were assessed across the 25 sessions resulting in data collection from a total of 449 individual sessions. 4 players were not included in data analysis as a result of being taken out of the playing roster due to injuries. Sessions included 55 individual sessions recorded for lifts, 240 individual sessions recorded for ice sessions, and 154 individual session recorded for games. The numbers of sessions recorded per player are presented in Tables 6.

7.1 Implementation of the Pre-planned Periodized Training Program

Average TLs for each of the training modalities and for games are outlined in Table 5. Results demonstrate dissimilarities between PTL's, TEAM's and groups' TLs. The most similar loading pattern is demonstrated between Total PTL and Total Team TL, while the largest dissimilarity is revealed between Lift PTL and D's Lift TL (45%).

Table 5. Average TLs

Group	Total (% of PTL)	Game (% of PTL)	Ice (% of PTL)	Lift (% of PTL)
PTL	503.3 (100%)	851.4 (100%)	216.2 (100%)	200.0 (100%)
TEAM	510.7 (101%)	812.1 (95%)	264.3 (122%)	164.0 (82%)
Defence	492.9 (98%)	756.3 (89%)	258.9 (120%)	109.1 (55%)
Forwards	540.6 (107%)	853.8 (100%)	271.2 (125%)	152.0 (76%)
Goalies	467.4 (93%)	746.9 (88%)	220.8 (102%)	153.3 (77%)
Freshmen	467.8 (93%)	692.8 (81%)	273.1 (126%)	168.9 (84%)
Sophomores	516.1 (103%)	833.3 (98%)	260.3 (120%)	156.7 (78%)
Juniors	495.2 (98%)	812.5 (95%)	239.7 (111%)	155.2 (78%)
Seniors	554.0 (110%)	892.2 (105%)	279.3 (129%)	176.0 (88%)

Graphs representing the pre-planned periodized program are outlined in Attachment 7 and 8. In both PTL and the executed training program, all groups perceived games to be more demanding than training, highest daily TLs (excluding game days) were recorded on days when both Lift and Ice were performed and lowest TLs were recorded on Thursdays (one day before weekend competition).

Daily TLs were perceived differently than PTL. For example, training performed on Wednesday, 12th of February, resulted in TLs of 300, 468, 429, 517.14 and 312 for PTL, Team, Defensemen (D), Forwards (F), and Goalies (G), respectfully. The fluctuation of daily TLs was similar to PTL, with the following exceptions:

- Game PTL remained constant while actual game TLs varied.
- G's TLs fluctuation between February 4th and February 5th (Feb 4 TL < Feb 5 TL) was contrary to PTL (Feb 4 TL > Feb 5 TL).
- G's TL fluctuation between February 28th, March 1st and March 2nd (Feb 28 TL< Mar 1 TL>Mar 2 TL) was contrary to PTL (Feb 28 TL> Mar 1 TL<Mar 2 TL).
- FR's TL fluctuation between February 14th and February 15th (Feb 14 TL > Feb 15 TL) was contrary to PTL (Feb 14 TL < Feb 15 TL).
- SO's TL fluctuation between February 28th, March 1st and March 2nd (Feb 28 TL> Mar 1 TL>Mar 2 TL) was contrary to PTL (Feb 28 TL> Mar 1 TL<Mar 2 TL).

Graphs representing total weekly TLs (Figure 2.) demonstrate variations in weekly TL. The fluctuation in TLs was similar to PTL, with the following exceptions:

- G did not follow the same load variation, as W2TL was the lowest, not week 3.
- SE and JU did not follow the same load variation, as W2TL was the lowest, not week 3.

Additionally, within a specific week, weekly TLs varied from PTL For example, W2TL resulted in TLs of 2622.8, 2673.5, 2580.61, 2768.64, 2179.95, 2598.83, 2978.44, 2466.84 and 2712.95 for PTL, Team, D, F, G, for FR, SO, JU and SE respectfully.

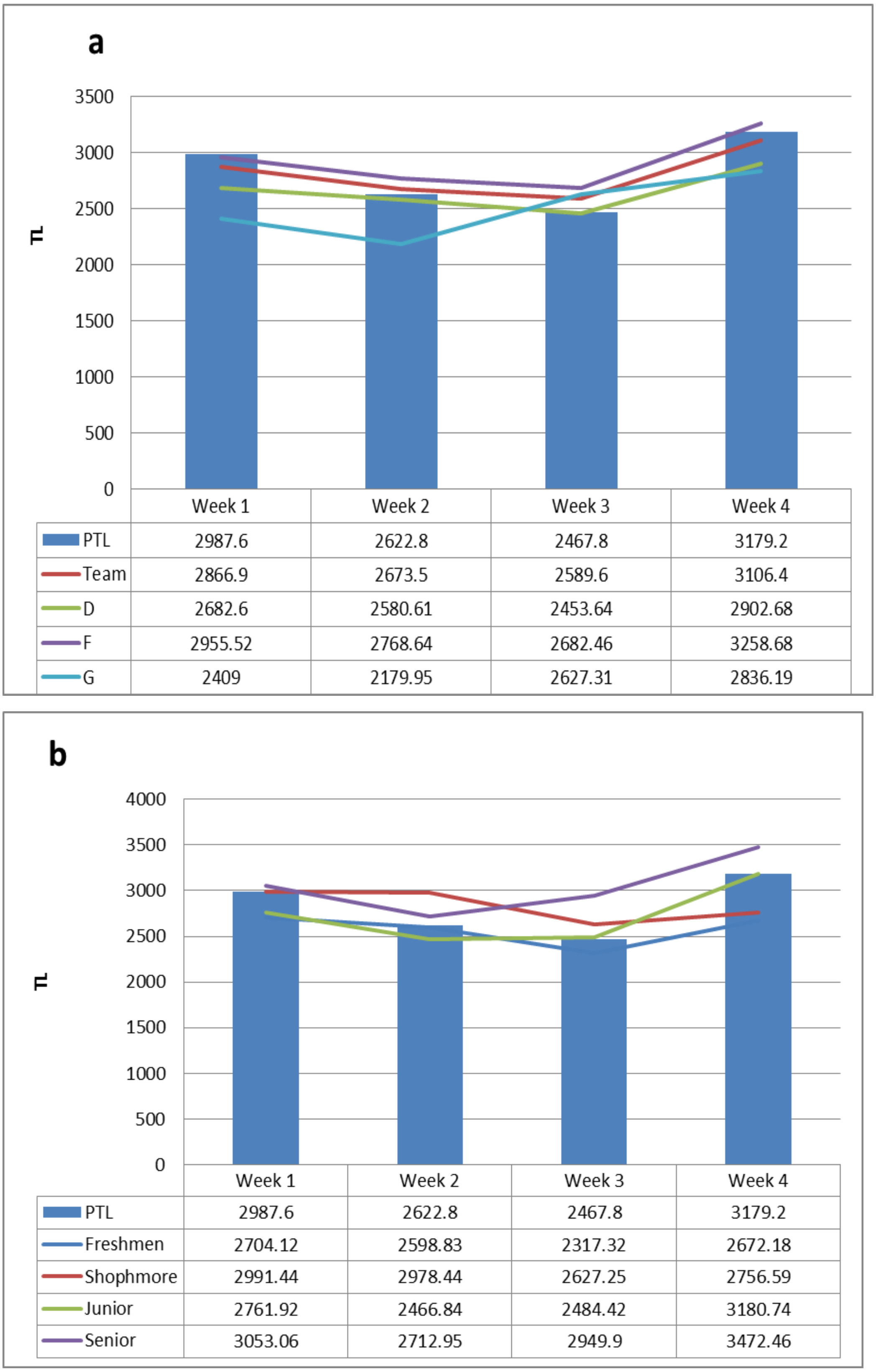
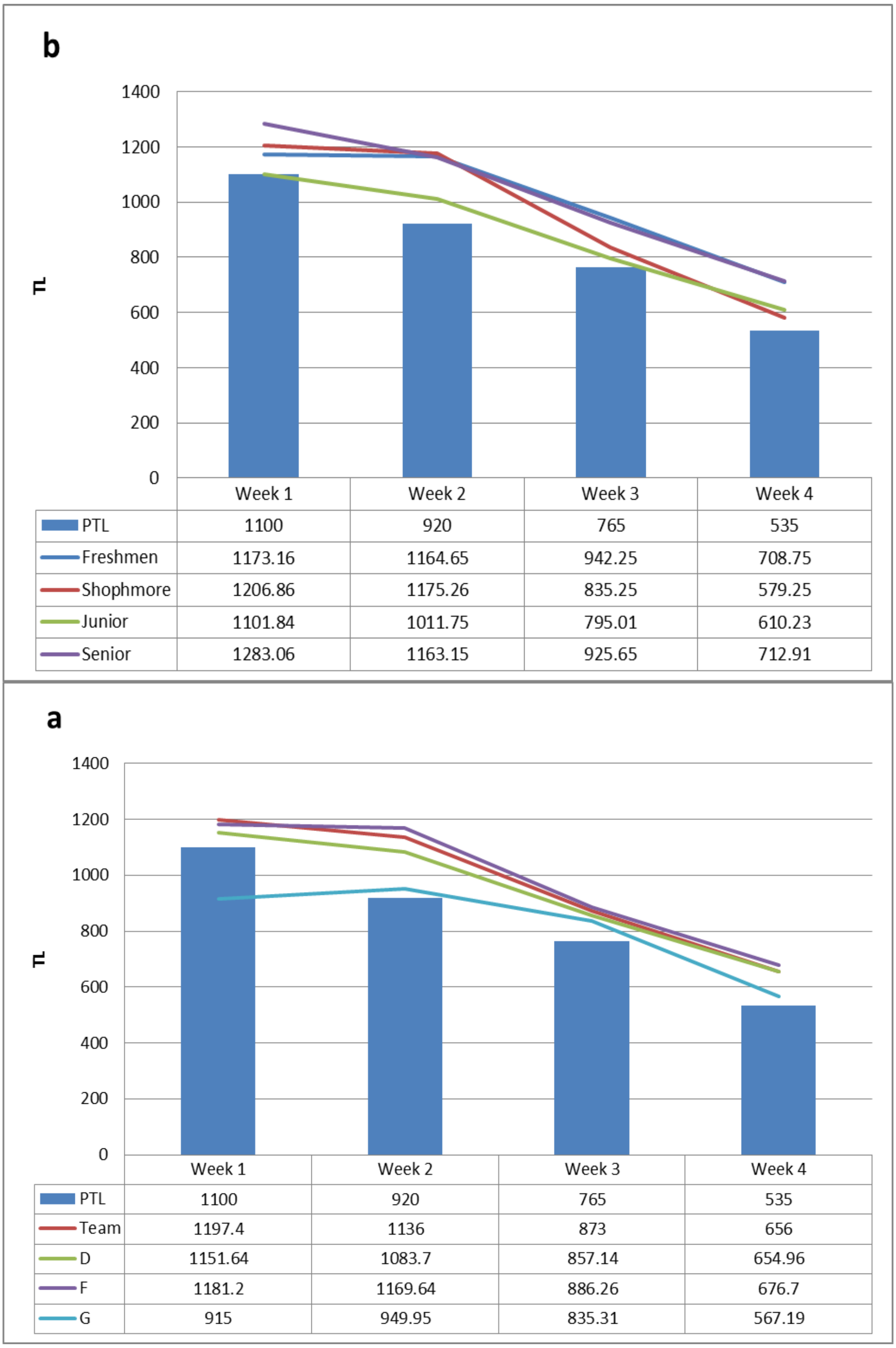


Figure 2. Total Weekly TLs Segmented by Position (a) and by Experience (b)

In addition, weekly practice TLs (excluding games) varied from PTL. For example, W2TLs were 920, 1136, 1083.7, 1169.64, 949.95, 1164.65, 1175.26, 1011.75 and

1163.15 for PTL, TEAM, D, F, G, FR, SO, JU and SE, respectfully. The fluctuation of TLs for all groups were according to PTL, excepting G's TL which fluctuated differently between week 1 and week 2 (W1TL<W2TL) (Figure 3.).



	Week 1	Week 2	Week 3	Week 4
PTL	1100	920	765	535
Freshmen	1173.16	1164.65	942.25	708.75
Shophmore	1206.86	1175.26	835.25	579.25
Junior	1101.84	1011.75	795.01	610.23
Senior	1283.06	1163.15	925.65	712.91

	Week 1	Week 2	Week 3	Week 4
PTL	1100	920	765	535
Team	1197.4	1136	873	656
D	1151.64	1083.7	857.14	654.96
F	1181.2	1169.64	886.26	676.7
G	915	949.95	835.31	567.19

Figure 3. Weekly Practice TLs Segmented by Position (a) and by Experience (b)

7.2 Load Measures of Groups Segmented by Position

TLs encountered by different positions are outlines in Table 5. Average TL resulting from all session (Ices, Lifts and Games) varied between positions. F's TLs were the greatest, whereas G's TLs were the lowest. A difference of 14% is demonstrated between the groups. Additionally, average Game TLs varied between groups. The greatest TLs were recorded for F, whereas lowest TLs were recorded for G. A difference of 12% is demonstrated between the two groups. Furthermore, average Ice TLs varied between groups as well. Greatest TLs were recorded for F, while G's were the lowest. A difference of 23% is demonstrated between the groups. Lastly, average Lift TLs also varied between groups. The greatest TLs achieved during lifts were by G whereas the lowest were demonstrated by D. A difference of 22% is demonstrated between the groups. None of the groups achieved Lift PTL.

Graphs representing total weekly TLs segmented by position (Figure 3.) demonstrate variations in weekly TLs. F's and D's TLs fluctuated accordingly: week 1 TL was greater than week 2 TL (W1TL >W2TL), week 2 TL was greater than week 3 TL (W2TL>W3TL) and Week 4 TL (W4TL) was greatest. G did not follow the same load variation, as W2TL was the lowest, not week 3. Additionally, within a specific week, weekly TLs were different according to position. For example, W2TL resulted in TLs of 2622.8, 2673.5, 2580.61, 2768.64 and 2179.95 for PTL, Team, D, F, and G, respectfully.

Monthly TLs varied between groups and were 11236.4, 10843.1, 11893.3 and 10282.5 for TEAM, D, F and G, respectfully. The greatest TL was experienced by F whereas the lowest were experienced by G. The difference between the two groups is 14.6% (Figures 4.).

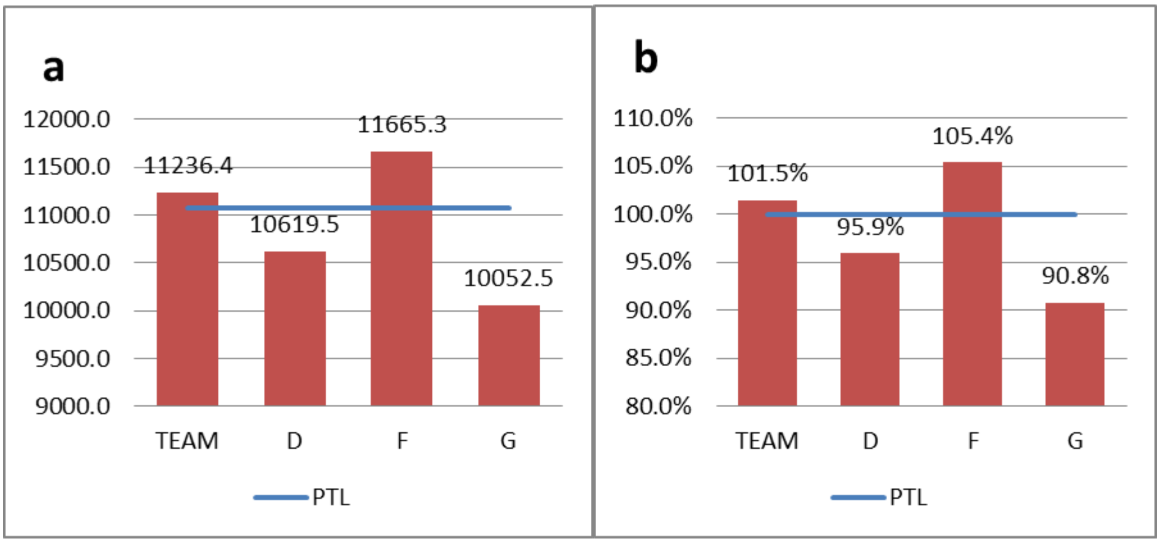


Figure 4. Total Monthly TLs Segmented by Position, Expressed in Total TL Values (a) and By Percentage of PTL (b)

7.3 Load Measures of Groups Segmented by Experience Level

TLs encountered by groups segmented by experience levels are outlines in Table 5. Average TL resulting from all session (Ices, Lifts and Games) varied between groups. SE's TLs were the greatest, whereas FR's TLs were the lowest. A difference of 17% is demonstrated between the groups. Additionally, average game TLs varied between groups. The greatest TLs were recorded for SE, whereas the lowest were recorded for FR. A difference of 24% is demonstrated between the groups. Furthermore, average Ice TLs varied between groups as well. Greatest TLs were recorded for SE, while JU's TLs were the lowest. A difference of 18% is demonstrated between groups. Lastly, average Lift TLs also varied between groups. The greatest TLs achieved during lifts were by SE, whereas the lowest were demonstrated by JU. A difference of 10% is demonstrated between the groups.

Graphs representing variation in TLs segmented by experience (Attachment 8.) reveal variations in day to day TL when segmented by experience level. The fluctuation of daily TLs were similar for all groups, with the exception of the fluctuation of FR's TL between February 14th and February 15th (Feb 14 TL > Feb 15 TL), which was contrary to SO's TL, JU's TL and SE's TL fluctuation (Feb 14 TL < Feb 15 TL), and SO's TL fluctuation between February 28th, March 1st and March 2nd (Feb 28 TL> Mar 1

TL>Mar 2 TL), which was contrary to FR's, JU's and SE's TLs' fluctuation (Feb 28 TL> Mar 1 TL<Mar 2 TL). Additionally, Daily TLs were perceived differently according to experience level. For example, Ice performed on Wednesday, 12th of February, resulted in TLs of 526.5, 520.26, 374.4 and 448, for, Freshmen (FR), Sophomores (SO), Juniors (JU) and Seniors (SE), respectfully.

Monthly TLs varied between groups and were 9788.5, 10920.2, 10489.5, & 12188.4 for FR, SO, JU and SE, respectfully. Greatest TLs were experienced by SE, whereas lowest were experienced by FR. The difference between the two groups is 17.1% (Figure 5.).

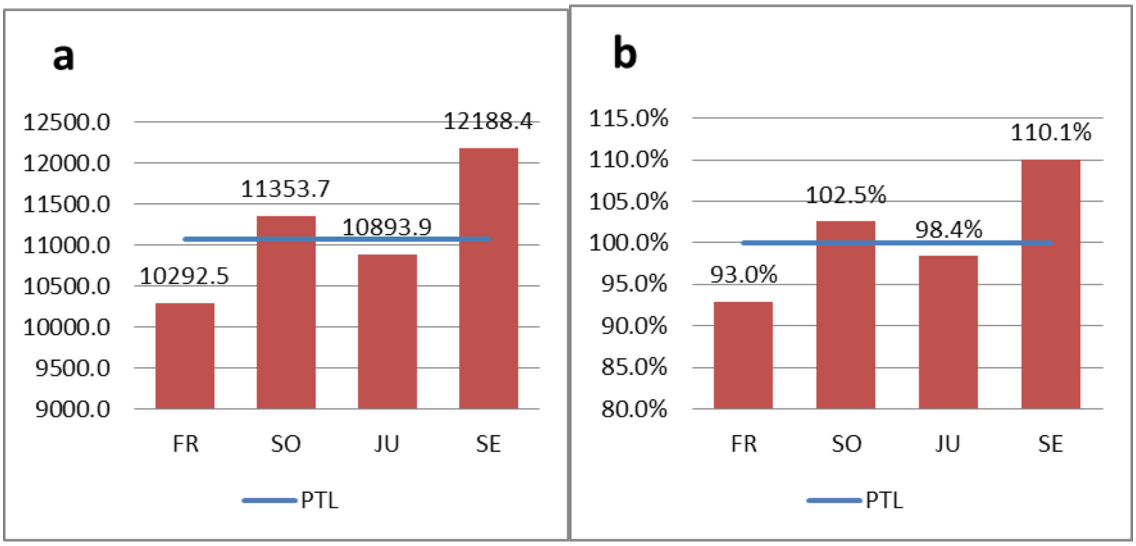


Figure 5. Total Monthly TLs Segmented by Experience Level, Expressed in Total TL Values (a) and By Percentage of PTL (b)

7.4 Load Measures of Individual Players

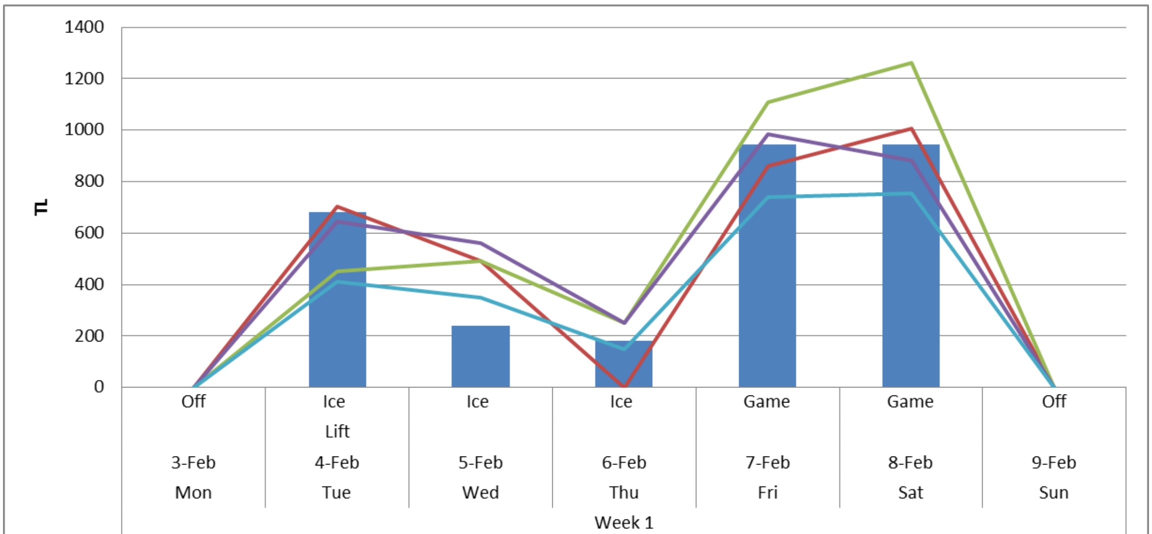
Training load measures for each of the players are presented in Table 6. Greatest Total TLs recorded were D20's and F1's, whereas the lowest were D16's and F5's. The difference in TLs between those players was 80.4%. Additionally, for games, greatest Total TLs recorded were F1's, whereas the lowest were D16's. The difference between the two players was 99.9%. Finally, for practices, greatest Total TLs recorded were D20's, whereas the lowest were D19's. The difference between the two players was 55.9%.

Table 6. Individual Players' TLs

Player	Sessions Recorded	Total (% of PTL)	Game (% of PTL)	Practice (% of PTL)
PTL	23	11072.6 (100%)	7752.6 (100%)	3320 (100%)
F1 (SE)	23	12363 (111.7%)	8804 (113.6%)	3558 (107.2%)
F2 (JU)	23	11632 (105.1%)	7645 (98.6%)	3985 (120%)
F3 (JU)	24	10874 (98.2%)	7765 (100.2%)	3106 (93.6%)
F4 (SO)	25	12848 (116%)	8514 (109.8%)	4330 (130.4%)
F5 (FR)	25	6964 (62.9%)	3434 (44.3%)	3525 (106.2%)
F6 (SE)	24	11036 (99.7%)	6672 (86.1%)	4358 (131.3%)
F7 (SO)	25	12717 (114.9%)	8640 (111.4%)	4070 (122.6%)
F8 (SO)	NA as a result of injury			
F9 (JU)	25	11989 (108.3%)	8512 (109.8%)	3468 (104.5%)
F10 (FR)	NA as a result of injury			
F11 (SE)	25	12272 (110.8%)	8522 (109.9%)	3739 (112.6%)
F12 (FR)	23	11658.5 (105.3%)	8084.5 (104.3%)	3562 (107.3%)
D13 (SO)	24	8302 (75%)	5296 (68.3%)	2993 (90.2%)
D14 (SO)	NA as a result of injury			
D15 (JU)	22	10097 91.2%)	7165 (92.4%)	2917 (87.9%)
D16 (FR)	13	4276 (38.6%)	1062 (13.7%)	3198 (96.3%)
D17 (JU)	25	9897 (89.4%)	6502 (83.9%)	3378 (101.7%)
D18 (FR)	24	11994 (108.3%)	7540 (97.3%)	4436 (133.6%)
D19 (JU)	24	9320 (84.2%)	6635 (85.6%)	2666 (80.3%)
D20 (SE)	25	13182 (119.1%)	8641 (111.5%)	4521 (136.2%)
G21 (SE)	23	8285 (74.8%)	5200 (67.1%)	3064 (92.3%)
G22 (JU)	NA as a result of injury			
G23 (SE)	14	5875 (51.3%)	1648 (21.3%)	4204 (126.6%)

RPE scores reported by the team following training sessions and competitions are presented in Attachment 3. The scores demonstrate differences in perception of exertion between the players. For example, Lift and Ice sessions performed on February 5th, resulted in a RPE score (mean±SD) of 4.5±1.1 and 6.3±1.5, respectfully. Additionally, sRPE scores also differed between players. For example, ice session performed on February 13th resulted in TLs of 275, 165, 220 and 330 for F1, F3, F9 and G23, respectfully (Attachment 7.).

Example of individual players' (F2, F11, D 20 & G21) daily TL during week 1 and their resulting fluctuation patterns are presented in Figure 6. The graph represents different daily TLs between players and a different relation between players' day to day loading patterns. For example, the relationship between Feb7TL and Feb8 TL for F2 is Feb7TL<Feb8TL, while for D20 the relationship is reversed.



	3-Feb Mon	4-Feb Tue	5-Feb Wed	6-Feb Thu	7-Feb Fri	8-Feb Sat	9-Feb Sun
PTL	0	680	240	180	943.8	943.8	0
F2	0	704	490	0	861	1008	0
F11	0	450	490	250	1107	1260	0
D20	0	646	560	250	984	882	0
G21	0	410	350	150	738	756	0

Figure 6. F2's, F11's, D20's and G21's Daily TLs and Their Fluctuation during Week 1

8 Discussion

Firstly, it is important to note that the experience gained during this study supports sRPE being a relatively reliable and simple method of monitoring TLs and it is the author's recommendation that coaches, at any level, consider applying this method on their team. Secondly, the results of this study back the notion that TL monitoring is a valuable method which allows the coach to evaluate the implementation of his pre-planned program. Regardless of the nature of the results revealed, a tool enabling visual feedback and documentation of trainings must be considered valuable in any coaching environment. Thirdly, a clear advantage of sRPE is its ability to provide a single TRIMP value which simplifies the evaluation of training. Again, the simplicity of the feedback provided should allow coaches at various levels to draw conclusion regarding their training methods and adapt them favorably. Fourthly, monitoring training revealed in loading patterns during practice and competition between groups constructing the same team and between individual athletes. The excavation of these differences is of value as it appears a team average is not representative of TLs encountered by the athletes (Table 5-6.). It is the author's opinion, that here lays the most beneficial and important piece the method contains, as it is a potential tool enabling an individualization of training protocols in the team sport environment.

8.1 Monitoring the Implementation of the Periodized Training Plan

All measures of TL in the current study were shown to fluctuate greatly across the training sessions assessed (Attachment 7-8.), reflecting the team's periodized training plan. Although Actual TLs experienced by the TEAM were similar to PTL (101 %) (Table 5.) and fluctuation in TEAM TLs resembled PTL (Attachment 7.) a conclusion that the team executed coaches' PTL according to plan would be wrong. Firstly, a clear dissimilarity is evident between coaches' prediction of TLs and the TLs encountered by the athletes in regards to total and average TLs. The dissimilarity is confirmed on a daily basis; a weekly basis; a monthly basis; for different training modules; when segmented by players; when segmented by position; and when segmented by experience.

Secondly, dissimilarity is evident in the implementation in load fluctuation within the periodized training plan. Coaches' periodized plan demonstrated a strategy of tapering – a reduction in TLs during the final stages before important competition with the aim of optimizing performance (Arisvisa et al. 2007, 1358). Within each week tapering strategies were performed by reducing TLs of practice as the week proceeded towards games, specifically during Thursdays (one day prior to competition) (Attachments 7-8. and Figure 6.). During the 4 weeks a clear tapering in practice TL is evident in both the planned and actual program, as weekly TLs are reduced gradually from week 1 to week 4 (Figure 3.)

Considering the team as one unit, we would find that the 4 week taper strategy was according to PTL. However, concluding that all positions experienced the coaches' intended tapering strategies would be misleading as G's fluctuation showed a contrary relation between week 1and week 2 TLs (W1TL<W2TL) with comparison to PTL. Furthermore, when game TLs are included (Figure 2.) it is evident that a 3 week taper in loads was planned but was not achieved by all groups. Once more, if we were to consider the team as one inseparable unit, we would be misled to believe optimal tapering strategies were achieved. However, G's, JU's and SE's TL fluctuations were contrary to those planned as they experienced an increase in TLs from week 2 to week 3. It can be concluded that coaches tapering strategies were achieved when considering the team as a whole, however segmenting the team reveals a more accurate picture of the patterns experienced by the team. On this level, the periodized plan was accurately implemented only by portions of the team. Notably, the detailed data collected using sRPE demonstrates it to be a useful tool in monitoring TLs and that implementing periodized programming is a complex issue in team sports.

8.2 Training Load Variation between Groups

FR reduced TLs is contrary to Coutts, Slattery and Wallace (Monitoring Training Loads) conclusion that FR are a group vulnerable to over training. However, it is important to note that Coutts, Slattery and Wallace (Monitoring Training Loads) do not mention for which sport, population or during which part of the season freshmen's TLs were evidently higher. If they were referring to practice TLs solely, FR's practice

TLs resulted in 120% of PTL (Table 5.) and thus the results could agree with their conclusion.

Although FR's TL were not found to predict overtraining, the investigation of TL distribution between groups revealed Goalies experience crucially low TLs. Goalies experienced lowest TLs during the 4 week period.; they experienced lowest TL for all sessions partaken on the ice (Ice + Game); they experienced crucially low TLs for all practice sessions (Ice + Lift); and experienced lower than TEAM TLs during Lifts (Table 5.). Consequently, it is plausible to conclude goalies are more likely to experience reduced TLs during the competition phase of the season. Furthermore, it is clear that the backup goaltenders would be even more likely to experience reduced TLs during this phase as their participation in games is limited. For example, the backup goaltender participated in 2 of 9 games played during the 4 weeks, resulting in 21.3% of Game PTL (Table 6.).

Greatest TLs were experienced by SE. Their TLs were greatest following all modules of training and following competition suggesting their venerability to enhanced TLs during all segments of the season. These results are contrary to Coutts, Slattery and Wallace (Monitoring Training Loads) who mention younger players', rather than older players', tendency to experience enhanced TLs.

8.3 Individual Players Responses to The Training Schedule

It is evident that players' response to the same training schedule varied significantly. Players TLs differed both when quantifying all sessions together, and when quantifying games and practices separately. For example, F1's Total TL (12363) was 2.9 times higher than D16's TLs (4276) and 2.1 times higher than G23's TLs (5875) (Table 6.). Arisvisa, Bosquet, Montpetit & Mujik (2007, 1358-1365) meta-analysis examining the effects of tapered TLs on performance suggested that an 85% reduction in TL would be considered as de-loaded stimuli (Banister, Carter & Zarkadas 1999, 182-191 in Arisvisa, et al. 2007, 1358). During the training schedule 6 players experienced total TLs lower than 85% of PTL (F5, D13, D16, D19, G21 and G23), 1 player's TLs following practices resulted in experiencing less than 85% of PTL (D19), and 7 players experienced less than 85% of PTL following games (F5, D13, D16, D17, D19, G21 and G23) (Tables 6). Accordingly, it can be concluded that 6 players experienced de-loaded stimuli throughout the entire 4 weeks of training; 1 player experienced de-loaded practice stimuli and 7 players experienced de-loaded game stimuli. These findings support the need to monitor each player's TL on an individual bases as neither TEAM, or other segmentation would reveal the crucial differences in TLs experience by players.

Although the investigation of TL distribution between practice and games was not the intent of the author, it is interesting to note Game TLs represented 70% of PTL and 65.6 % of TEAM TL (Table 6.). Hence, it is evident games have a greater effect on total TLs during the competition phase. The effect games have on total TLs was evident on the individual level as all six players experiencing total de-loaded stimuli experienced de-loaded stimuli following games, whereas only one experienced de-loaded stimuli during practice. Moreover, the influence of Game TLs on total TLs suggests that TL variation increases during the competition phase and therefore it is crucial TLs be monitored on an individual basis during this phase.

8.4 Limitations

Firstly and most importantly, the use of sRPE in ice hockey is limited as it has not been investigated with the purpose of validating its use in the sport. Research has not been done comparing sRPE to objective means of quantifying internal nor external TLs, such as HR-based methods, lactate accumulation or distance travelled. Research in the specific sport might find specific issues that must be taken into account when applying the method or might delegitimize its use completely. However, to the best of the author's knowledge, none of the investigations regarding team sports have yet to conclude sRPE to be an invalid method of quantifying TLs in their specific sport and thus it's highly plausible they will be found suitable in ice hockey.

Secondly, although sRPE has been validated as a mean of quantifying different modalities of exercises, (Dodge et al. 2001, 109-115), Decker et al. (2007, 762-769) demonstrated a significant limitation of sRPE in its ability to quantifying different types of training. Their research concluded that specific exercise components will not have a substantial influence on TL in a given training period using sRPE. For that reason, a graph presenting TLs attained using sRPE might overvalue or undervalue specific modules of the training.

Lastly, data collected were limited to one team, one coaching staff , to the population of 19 women, collegian ice hockey players, ages 20.47±1.31 and to 4 weeks of the competition phase of the season. These variables limit our ability to reach conclusions in the following manner: (1) playing in college is limited to 4 seasons, limiting experience levels accordingly, (2) the results are gender specific, (3) the results represent one team, not an average of numerous teams and thus might be a poor representative of trends typical to teams of this type, (4) conclusion regarding the ability of coaches to implement planned periodized programming are limited to the following staff alone and thus might be a poor representative of typical trends, and (5) data is limited to trends exclusively during the competition phase.

8.5 Conclusion

Monitoring TLs is an essential part of implementing a periodized training plan in any sporting environment. Murphy (2013, 96) states - "Limited studies have provided specific examples of workload monitoring strategies for contemporary tennis populations, whilst many studies in other sporting populations have developed monitoring initiatives which tennis has the potential to adopt. Monitoring of both training and competition loads have been identified as vital performance tracking indicators in modern day, elite tennis environments. Therefore, appropriate workload monitoring techniques play an important role in elite level athlete development". It is advisable that ice hockey professionals follow in the footsteps of colleagues from other sports by beginning to investigate TL monitoring methods appropriate in our sport. In order to do so, it is vital researchers validate a mean of quantifying TLs in ice hockey. However, until that day, sRPE can be considered a useful measuring tool and can be implemented in a relatively simple and cheap way.

The application of TL monitoring in ice hockey has revealed monitoring a team without further dividing it into smaller details is wrongful, as it leads to misleading conclusions. By monitoring smaller segments of the team, coaches can evaluate their athletes' tolerance to training and the variation in load measures between groups of players. In this research, a correlation between experience level and reduced TLs was not found. However, goalies have been found to experience reduced TLs, while seniors have been found to experience enhanced TLs. Future research compiling data regarding both populations could determine these trends typical or untypical in the sport and recommend training practice adaptations accordingly.

It is the author's hope that the findings of this article will enhance the application of TL monitoring in ice hockey. Specifically, the author encourages individualization of training monitoring and training protocol, as players' loads vary significantly although they partake in the same training regime. Eventually, adapted protocols might lead to advancements in training, resulting in a higher chance of players achieving their genetic potential and experiencing enhanced performance. Monitoring individual players' TLs can be done by the players using a weekly training diary (Table 7.) or by the coaching staff (Attachment 5.)

Table 7. Example of Weekly Training Dairy for the Ice Hockey Player

Day	Activity	Comments	RPE	Duration (min)	TL (sRPE)
Sun	Off		0	0	0
Mon	Ice + Lift		5+7	45+45	1080
Tues	Ice		7	60	420
Wed	Ice +Lift		5+7	45+45	1080
Thurs	Ice		4	30	120
Fri	Game		7	120	840
Sat	Game		8	120	960
Weekly Load	4500				

Bibliography

Alexiou, H. & Coutts A. 2008. A Comparioson of Mehtods Used for Quantifying Internal Loads in Women Soccer Players. International Journal of Sports Physiology and Performance, 3, pp. 320-330.

Altimari, L., Dantas, J., Fontes, E., Moraes, A. Nakamura, F., Okano, A., Pereira, G. & Smirmaul, B. The Relationship Between Rating of Perceived Exertion and Muscle Activity During Exhaustive Constant-Load Cycling. 2010. Int J Sports Med, 31, 10, pp. 683-688.

Atkinson, G., Drust, B. & and Reilly, T. 2007. Future Perspectives in the Evaluation of the Physiological Demands of Soccer. Sports Med, 37, 9, pp. 783-805.

Aughey, R., Boyd, L., Coutts, A., Cormack, S. & Denise, J. 2010. The Validity and Reliability of GPS Units for Measuring Distance in Team Sport Specific Running Patterns. International Journal of Sports Physiology and Performance, 5, 328-341

Baechle, T. 1994. Essentials of Strength Training and Conditioning. National Strength and Conditioning Assosiation. Human Kinetics, P.O. Box 5076, Champaign, IL 61825-5076

Banister, E., Carter, J. & Zarkadas, P. 1999. Training theory and taper: validation in triathlon athletes. Eur. J. Appl. Physiol. 79, pp. 182–191.

Banister, E., Calvert, T., Savage, M. & Bach, T. 1975. A systems model of training for athletic performance. Aust. J. Sports Med. 7, pp. 57–61.

Batada, A., Burnett, M., Cole, B., Green, H., Kollias, H., McKay, S., Roy, B., Schertzer, J., Smith, I. & Tupling, S. 2010. Cellular responses in skeletal muscle to a season of ice hockey. Applied Physiology, Nutrition and Metabolism, 35, 5, pp. 657-670.

Bompa, T. & Cahmbers, D. 2003. Total Hockey Conditioning: from pee-wee to pro. 1st Ed. Fire Books (U.S.) Inc. P.O. Box 1338, Ellicott Station, Buffalo New York, USA 14205.

Borg, G. Borg's Percieved Exertion and Pain Scales. 1998. Champaign, IL: Human Kinetics.

Borresen, J. & Lambert M. 2010. Measuring Training Load in Sports. International Journal of Sports Physiology and Performance, 5, pp. 406-411

Borresen, J. & Lambert M. 2009. The Quantification of Training Load, the Training Response and the Effect on Performance. Sports Med, 39, 9, pp. 779-795

Bosquer, L., Denis, A., Montpetti, J. & Mujika, I. 2007. Effects of Tapering on Performance: A Meta-Analysis. Medicine & Science in Sprots & Exercise, pp. 1358-1365.

Bracko, M. 2004. Biomechanics performance powers ice hockey. Biomechanics, 11, 9, pp. 47-53.

Brewer, J., Ramsbottom, r. & Williams, C. 1988. A Progressive shuttle run test to estimate maximal oxygen uptake. British Journal of Sports Medicine, 22, pp. 141-5.

Brice, G., Foster, C., Mcguigan, M., & Meghan L. 2004. Monitoring Exercise Intensity during Resistance Training Using the Session RPE Scale. Journal of Strength and Conditioning, 18, 2, pp. 353-358.

Castagna, C., Chamari, K., Chaouachi, A., D'Ottavio, S., Implellizzeri, F. & Manzi, V. 2010. Profile of Weekly Loads in Elite Male Professional Basketball Player. Journal of Strength and Conditioning Research, J Strength Cond Res, 24, 5, pp. 1399-1406.

Clark, A., Janse de Jonge, X., Knight, T., Lockie, R. & Scott, B. 2013. A Comparison of Methods to Quantify the In-Season Training Load of Professional Soccer Players. International Journal of Sports Physioiogy and Performance, 8, pp. 195-202.

Coutts, A., Franco, M., Impellizzeri, F., Marcora, S., Rampinini, E. & Sassi, A. 2004. Use of RPE-Based Training Load in Soccer. Medicine & Science in Sports & Exercise, 36, 6, pp. 1042- 1047.

Coutts, A., Wallace, L. & Slattery K. Monitoring Training Loads. URL: http://www.ausport.gov.au/sportscoachmag/development_and_maturation2/monitoring_training_load. Quoted: 17.3.2014.

Coutts, A., Wallace, L. & Slattery K. 2009. The Ecological Validity and Application of the session-RPE Method for Quantifying Training Loads in Swimming. Journal of Strength and Conditioning, 23, 1, pp. 33-38.

Cox, M., Miller, D., Verde. T., & Rhodes, E. 1995. Applied Physiology of Ice Hockey. Sports Med. 19, 3, pp. 161-234

Crews, T., Green, J., Lomax, R., McLester, J., Pritchett, R. & Wickwire, P. 2006. RPE Association with Lactate and Heart Rate during High-Intensity Interval Cycling. Med Sci Sports Exerc, 38, 1, pp. 167-172.

Decker, L., Desgorces, F.D., Garcia, J., Noirez, P. & Senegas, X. 2007. Methods to Quantify Intermittent Exercises. Appl. Physiol. Nutr. Metab, 32, pp. 762-769.

Dodge, C., Doleshai, P., Florhaug, J., Parker, S., Foster, C. Gottschall, L., Hrovatin, A. & Franklin, J. 2001. A New Approach to Monitoring Exercise Training Journal of Strength and Conditioning Research, 15, 1, pp.109-115.

Edwards, S. 1993. High performance training and racing. The heart rate monitor book. Fleet Press, Sacramento, pp. 113–123.

Eston, R. 2012. Use of Raitng of Perceived Exertion in Sports. International Journal of Sports Physiology and Performance, 7, pp. 175-182.

Foster, C., Glenn, B., Travis, W., McGuigan, M. & W. Sweer. 2004. Quantitation of Resistance Training Using the Session Rating of Perceived Exertion Method, Journal of Strength and Conditioning Research, 18, 4, pp. 796-802.

Gabbett, T., Jenkins, D. & King, T. 2008. Applied Physiology of Rugby League Sports Med, 38, 2, pp. 119-138

Gamble, P. 2012. Training for Sport Speed and Agility: An Evidence Based Approach, Taylor & Francis Ltd, London, Great Britain.

Green, H., Bishop, P., Houston, M., McKillop, R. & Norman, R. 1976. Time Motion and Physiological Assessments of Ice Hockey Performance. Journal of Applied Physiology, 40, 2 , pp. 159-163.

Haff, G. 2010. Quantifying Workloads in Resistance Training: A Brief Review. UK Strength and Conditioning Assosiation, 19, pp. 31-40.

Hockey Canada. Long Term Player Development Pyramid. URL: http://www.hockeycanada.ca/en-ca/Hockey-Programs/Coaching/Essentials/Downloads.aspx. Quoted: 29.7.2013

IIHF Official Rule Book 2010-2014. Section 4 – Playing Rules. URL: http://www.iihf.com/fileadmin/user_upload/PDF/Sport/rulebook2010/Table_of_contents_1_9_-_29_September.pdf. Quoted: 6.10.2012.

Kilgore, R. & Rippetoe, M. 2006. Practical Programming for Strength Training. The Aagard Company. 3118 Buchanan, Wichita Falls, TX 76308, USA.

MacLean, E. A Theoretical Review of the Physiological Demands of Ice-Hockey and a Full Year Periodized Sport Specific Conditioning Program for the Canadian Junior Hockey Player . URL: http://performancetrainingsystems.net/Resources/Hockey%20Paper%20-%20Final.pdf. Quoted: 31/12/2013.

McGuigan, M. 2004. A New Approach to Monitoring Resistance Training. National Strength and Conditioning Association, 26, 6, pp. 42–47.

Murphy, A. 2013. Review of the Literature – Methods of External and Internal Training Load Monitoring in Elite Tennis Environments. J. Aust. Strength Cond, 21, 2, pp. 96-102.

National Hockey League Central Scouting Result. URL: http://centralscouting.nhl.com/link3/cs/public-home.nsf/page?readform&app=combine. Quoted: 7.10.2012.

National Hockey League Rule Book. Rule no. 1 – Rink. http://www.nhl.com/ice/page.htm?id=26458. Quoted: 3.4.2014

National Basketball Assosiation Rule Book. Rule no.. 3 - Players, Substitutes and Coaches. URL: http://www.nba.com/analysis/rules_3.html?nav=ArticleList. Quoted: 15.3.2014.

Rhodes, T. & Twist, P. 1993a. A Physiological Analysis of Ice Hockey Positions. Strength and Conditioning Journal, 15, 6, pp. 44-46.

Rhodes, T. & Twist, P. 1993b. The bioenergetic and physiological demands of ice hockey. National Strength and Conditioning Association Journal, 15, 68-70.

Taha, T., and Thomas, S. 2003. Systems modelling of the relationship between training and performance. Sports Med, 33, pp. 1061–1073.

USA Hockey. Long Term Athlete Development Model. Learn to Compete. URL: http://wwa.uahockey.com/ADMKids_8Stages.aspx. Quoted: 17.1.2014

Williams, M.. 2006. Nutrition for Health, Fitness, and Sports. 8th edition. McGraw-Hill Higher Education Headquarters, 1333 Burr Ridge Parkway, Burr Ridge, Il 60521.

Attachments

Attachment 1. Physical Characteristics of Elite Ice Hockey Players (Rhodes & Twist, 1993, 45)

Table 1. Mean VO_2 max and body weight values for National Hockey League players.

Position	N	Weight	VO_2 max ($ml.kg^{-1}$ min^{-1})
Forwards	*27	87.1(5.6)	57.4(3.1)
Defensemen	40	90.3(4.3)	54.8(3.9)
Goaltenders	8	79.2(3.9)	49.1(2.5)

Table 2. 1992 pre-season physiological profiles of NHL veterans.

	Forwards	Defensemen	Goaltenders
Age (yrs)	*24.8(4.6)	24.7(2.6)	27.3(4.5)
Height (in)	73.6(1.7)	73.8(1.9)	72.5(1.2)
Weight (lbs)	204.3(8.4)	207.1(9.3)	185.5(10.1)
Sum of six skinfolds (mm) (Ref 15)	39.5(5.3)	40.4(5.6)	4.3(11.6)
Percent Body Fat	10.8(2.4)	12.1(2.5)	13.5(3.1)
Anaerobic power (Wingate Test) watts/kg in 5 sec	13.4(1.2)	13.1(1.5)	12.7(1.1)
Anaerobic capacity (Wingate Test) watts/kg 30 sec	10.3(1.3)	10.2(0.9)	9.5(1.6)
Blood lactate (mmol/L)	15.1(2.1)	14.9(1.8)	14.9(2.2)
Grip strength (kg, left + right)	142.4(8.6)	138.1(9.4)	121.5(8.4)
200 lb bench press (max reps)	12.0(3.0)	14.0(3.3)	4.3(2.1)
Controlled sit ups (max 100) (ref 15)	59.0(21.0)	72.0(16.0)	58.0(8.2)
Hip flexion (degrees) (ref 9)	123.5(7.2)	126.5(8.6)	134.5(10.3)
Hip extension (degrees) (ref 9)	48.5(5.1)	48.0(5.0)	52.5(4.8)
Trunk flexion (cm) (ref 15)	45.0(7.4)	44.2(6.9)	52.5(4.8)

* X (= or - S.D.)

Attachment 2. IIHF Beep Test Procedure

The Beep Test Shuttle is a non-invasive, indirect maximal multistage test of aerobic fitness. Aerobic fitness is measured from the maximum rate that oxygen can be extracted from the atmosphere and transported to and used by the body's tissues (VO2 max). It is expressed in ml/kg/min. The shuttle running course consists of running back and forth in a gymnasium or on a running track, on a 20 m course at an initial speed of 8.5 km/h. The running speed is controlled by audio signals that allow the speed to be increased by 0.5 km/h each minute. At every sound signal, participants must reach the 20 m line, pivot, and get to the other line by the next audio signal. The test is terminated when a subject fails to reach within 1 m of the end line two times in succession. Performance on the 20m Shuttle Run will be evaluated as recommended by the Australian Sports Commission (1998). Scores are a product of the level and the number of successful shuttles completed for that level Eg 9.4.

For hockey, it is very important to have a minimal level of aerobic fitness to build a platform in which explosive power, muscular strength and anaerobic power can maximized. Generally speaking, athletes with high aerobic capacities have the ability to sustain high intense exercise and recover from repeated bouts of high intense exercise. This reflects one's ability to recover and play at a higher intensity during back-to-back shifts, periods, games, and overtime. Also, athletes with adequate levels of aerobic fitness generally recover faster from sicknesses, from periods of travel, and sleep better.

Required Equipment

- 1 x 20M Measuring
- 9" Saucer cones
- 1 Loud CD playing Stereo
- 1 x Australian Beep Test CD
- 1 Team Heart Rate Monitoring System (to be brought by Dawn Strout)

Attachment 3. RPE Record Sheet

Week		Week 1							Week 2							Week 3							Week 4						
Day		Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Date		4-Feb	5-Feb	6-Feb	7-Feb	8-Feb	9-Feb	10-Feb	11-Feb	12-Feb	13-Feb	14-Feb	15-Feb	16-Feb	17-Feb	18-Feb	19-Feb	20-Feb	21-Feb	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb	1-Mar	2-Mar	3-Mar
Session 1			Lift							Lift							Lift										Ice		
F	1		5														4										5		
	2		6							4							4										3		
	3		5							4							4										3		
	4		5							5							5										3		
	5		5							5							4										3		
	6		6							5							4										3		
	7		4							5							4										3		
	8		6																										
	9		4							4							4										3		
	10																												
	11		4							4							4										3		
	12									3							3										3		
D	13									3							3										3		
	14		2																										
	15		4														3										4		
	16		4							4							4										3		
	17		4							3							4										2		
	18		5							4							5										4		
	19		3							3							3										3		
	20		6							5							5										4		
G	21		3							3							4										3		
	22																4										3		
	23		5							4							4										3		
Average		#DIV/0!	4.5	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	4.0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	4.0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	3.2	#DIV/0!	#DIV/0!
SD		#DIV/0!	1.1	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0.8	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0.6	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0.6	#DIV/0!	#DIV/0!
Session 2			Ice	Ice	Ice	Game	Game				Ice	Ice	Game	Game	Ice		Ice	Ice	Ice	Game	Game			Ice	Ice	Ice	Game	Game	Game
F	1		8.5	6	4	7	8					5	6	7	4		5	5	5	8	8			5	6	5	8	9	9
	2		8	7		7	8				7	5	6	7	6		5	6		7	7			5	5	3	7	6	6
	3		4	5	4	7	7					3	6	7	5		5	5	3	7	7			4	5	4	7	6	8
	4		7	6	5	7	7				8	4	8	8	4		6	5	6	8	7			5	5	4	8	8	7
	5		6	6	2	4	6				6	5	6	4	4		4	4	3	3	1			3	4	4	1	1	1
	6		8	6	4	2	8				8	5	7	6	5		5	5	5	8	8			5	5	4	7	7	
	7		6	8	4	8	8				7	5	7	7	5		5	5	4	8	7			4	4	4	8	8	8
	8		7	5	5	7																							
	9		6	5	5	7	7				4	4	6	7	4		4	4	4	8	8			4	5	4	8	8	9
	10																												
	11		5	7	5	9	10				4	4	6	7	5		4	5	5	8	8			5	4	5	7	6	7
	12			6	5	8	7				9	3	6	6	4		5	5	4	8	6			6	6	4	8	7	8.5
D	13			6	3	6	7				5	3	7	7	7		4	4	4	5	5			4	4	4	2	2	1
	14																												
	15		8	6		6	7					5	5	7	5		6	4	4	6	6			6		4	6	7	7
	16		4	5	4	3	5				6						6	5	5					5	4	4			
	17		4	4	4	5	6				5	5	5	5	4		5	4	4	6	7			4	5	4	6	6	6
	18		7	7	8	6	7				6	5	7	6			6	7	6	7	7			6	6	5	7	6	7
	19		5		4	7	6				5	4	5	5	3		3	4	3	5	5			3	4	3	7	6	7
	20		7	8	5	8	7				6	5	7	7	5		5	5	5	7	9			6	6	5	8	7	9
G	21		5	5	3	6	6				5	3	4		4		4	4	3	7				3	4	3	5	7	6
	22										3	4			3		4	3	3		7			3	3	3			
	23		8	7	7							6		6	6		6	6	6					5	6	4			
Average		#DIV/0!	6.3	6.1	4.5	6.3	7.1	#DIV/0!	#DIV/0!	#DIV/0!	5.9	4.4	6.1	6.4	4.6	#DIV/0!	4.9	4.8	4.3	6.8	6.6	#DIV/0!	#DIV/0!	4.6	4.8	4.0	6.5	6.3	6.7
SD		#DIV/0!	1.5	1.1	1.4	1.8	1.1	#DIV/0!	#DIV/0!	#DIV/0!	1.6	0.9	1.0	1.0	1.0	#DIV/0!	0.9	0.9	1.1	1.4	1.8	#DIV/0!	#DIV/0!	1.1	0.9	0.6	2.1	2.0	2.4

- Freshmen
- Sophmores
- Juniors
- Seniors

Attachment 4. Individual Players sRPE Scores

Week		Week 1							Week 2						
Day		Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Date		3-Feb	4-Feb	5-Feb	6-Feb	7-Feb	8-Feb	9-Feb	10-Feb	11-Feb	12-Feb	13-Feb	14-Feb	15-Feb	16-Feb
Seesion 1		0	Lift	0	0	0	0	0	0	Lift	0	0	0	0	0
FORWARDS	1	0	200	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	240	0	0	0	0	0	0	160	0	0	0	0	0
	3	0	200	0	0	0	0	0	0	160	0	0	0	0	0
	4	0	200	0	0	0	0	0	0	200	0	0	0	0	0
	5	0	200	0	0	0	0	0	0	200	0	0	0	0	0
	6	0	240	0	0	0	0	0	0	200	0	0	0	0	0
	7	0	160	0	0	0	0	0	0	200	0	0	0	0	0
	8	0	240	0	0	0	0	0	0	0	0	0	0	0	0
	9	0	160	0	0	0	0	0	0	160	0	0	0	0	0
	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11	0	160	0	0	0	0	0	0	160	0	0	0	0	0
	12	0	0	0	0	0	0	0	0	120	0	0	0	0	0
DEFENSE	13	0	0	0	0	0	0	0	0	120	0	0	0	0	0
	14	0	80	0	0	0	0	0	0	80	0	0	0	0	0
	15	0	160	0	0	0	0	0	0	0	0	0	0	0	0
	16	0	160	0	0	0	0	0	0	160	0	0	0	0	0
	17	0	160	0	0	0	0	0	0	120	0	0	0	0	0
	18	0	200	0	0	0	0	0	0	160	0	0	0	0	0
	19	0	120	0	0	0	0	0	0	120	0	0	0	0	0
	20	0	240	0	0	0	0	0	0	200	0	0	0	0	0
GOALIES	21	0	120	0	0	0	0	0	0	120	0	0	0	0	0
	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	23	0	200	0	0	0	0	0	0	160	0	0	0	0	0
Session2		Off	Ice	Ice	Ice	Game	Game	Off	Off	Off	Ice	Ice	Game	Game	Ice
FORWARDS	1	0	493	420	200	861	1008	0	0	0	0	275	738	861	240
	2	0	464	490	0	861	1008	0	0	0	546	275	738	861	360
	3	0	232	350	200	861	882	0	0	0	0	165	738	861	300
	4	0	406	420	250	861	882	0	0	0	624	220	984	984	240
	5	0	348	420	100	492	756	0	0	0	468	275	738	492	240
	6	0	464	420	200	246	1008	0	0	0	624	275	861	738	300
	7	0	348	560	200	984	1008	0	0	0	546	275	861	861	300
	8	0	406	350	250	861	0	0	0	0	0	0	0	0	0
	9	0	348	350	250	861	882	0	0	0	312	220	738	861	240
	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11	0	290	490	250	1107	1260	0	0	0	312	220	738	861	300
	12	0	0	420	250	984	882	0	0	0	702	165	738	738	240
DEFENSE	13	0	0	420	150	738	882	0	0	0	390	165	861	861	420
	14	0	0	0	0	0	0	0	0	0	0	0	0	0	180
	15	0	464	420	0	738	882	0	0	0	0	275	615	861	300
	16	0	232	350	200	369	630	0	0	0	468	0	0	0	0
	17	0	232	280	200	615	756	0	0	0	390	275	615	615	240
	18	0	406	490	400	738	882	0	0	0	468	275	861	738	0
	19	0	290	0	200	861	756	0	0	0	390	220	615	615	180
	20	0	406	560	250	984	882	0	0	0	468	275	861	861	300
GOALIES	21	0	290	350	150	738	756	0	0	0	390	165	492	0	240
	22	0	0	0	0	0	0	0	0	0	234	220	0	0	180
	23	0	464	490	350	0	0	0	0	0	0	330	0	738	360

Freshmen
Sophmores
Juniors
Seniors

Total

Week		Week 1							Week 2						
Day		Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Date		3-Feb	4-Feb	5-Feb	6-Feb	7-Feb	8-Feb	9-Feb	10-Feb	11-Feb	12-Feb	13-Feb	14-Feb	15-Feb	16-Feb
Seesion 1			Lift							Lift					
Session2		Off	Ice	Ice	Ice	Game	Game	Off	Off	Off	Ice	Ice	Game	Game	Ice
FORWARDS	1		693	420	200	861	1008					275	738	861	240
	2		704	490		861	1008			160	546	275	738	861	360
	3		432	350	200	861	882			160		165	738	861	300
	4		606	420	250	861	882			200	624	220	984	984	240
	5		548	420	100	492	756			200	468	275	738	492	240
	6		704	420	200	246	1008			200	624	275	861	738	300
	7		508	560	200	984	1008			200	546	275	861	861	300
	8														
	9		508	350	250	861	882			160	312	220	738	861	240
	10														
	11		450	490	250	1107	1260			160	312	220	738	861	300
	12			420	250	984	882			120	702	165	738	738	240
DEFENSE	13			420	150	738	882			120	390	165	861	861	420
	14		80												
	15		624	420		738	882					275	615	861	300
	16		392	350	200	369	630			160	468	0			
	17		392	280	200	615	756			120	390	275	615	615	240
	18		606	490	400	738	882			160	468	275	861	738	
	19		410	0	200	861	756			120	390	220	615	615	180
	20		646	560	250	984	882			200	468	275	861	861	300
GOALIES	21		410	350	150	738	756			120	390	165	492		240
	22										234	220			180
	23		664	490	350					160		330		738	360
PTL			680	240	180	943.8	943.8			200	300	180	851.4	851.4	240

Freshmen
Sophmores
Juniors
Seniors

Week		Week 3							Week 4						
Day		Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Date		17-Feb	18-Feb	19-Feb	20-Feb	21-Feb	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb	1-Mar	2-Mar
Seesion 1		0	Lift	0	0	0	0	0	0	0	0	0	0	0	0
FORWARDS	1	0	160	0	0	0	0	0	0	0	0	0	105	0	0
	2	0	160	0	0	0	0	0	0	0	0	0	63	0	0
	3	0	160	0	0	0	0	0	0	0	0	0	63	0	0
	4	0	200	0	0	0	0	0	0	0	0	0	63	0	0
	5	0	160	0	0	0	0	0	0	0	0	0	63	0	0
	6	0	160	0	0	0	0	0	0	0	0	0	63	0	0
	7	0	160	0	0	0	0	0	0	0	0	0	63	0	0
	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	9	0	160	0	0	0	0	0	0	0	0	0	63	0	0
	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11	0	160	0	0	0	0	0	0	0	0	0	63	0	0
	12	0	120	0	0	0	0	0	0	0	0	0	63	0	0
DEFENSE	13	0	120	0	0	0	0	0	0	0	0	0	63	0	0
	14	0	120	0	0	0	0	0	0	0	0	0	42	0	0
	15	0	120	0	0	0	0	0	0	0	0	0	84	0	0
	16	0	160	0	0	0	0	0	0	0	0	0	63	0	0
	17	0	160	0	0	0	0	0	0	0	0	0	42	0	0
	18	0	200	0	0	0	0	0	0	0	0	0	84	0	0
	19	0	120	0	0	0	0	0	0	0	0	0	63	0	0
	20	0	200	0	0	0	0	0	0	0	0	0	84	0	0
GOALIES	21	0	160	0	0	0	0	0	0	0	0	0	63	0	0
	22	0	160	0	0	0	0	0	0	0	0	0	63	0	0
	23	0	160	0	0	0	0	0	0	0	0	0	63	0	0
Session2		Off	Ice	Ice	Ice	Game	Game	Off	Off	Ice	Ice	Ice	Game	Off	Game
FORWARDS	1	0	265	300	210	1080	968	0	0	260	360	175	960	1116	1107
	2	0	265	360	0	945	847	0	0	260	300	105	840	744	738
	3	0	265	300	126	945	847	0	0	208	300	140	840	744	984
	4	0	318	300	252	1080	847	0	0	260	300	140	960	992	861
	5	0	212	240	126	405	121	0	0	156	240	140	120	124	123
	6	0	265	300	210	1080	968	0	0	260	300	140	840	868	0
	7	0	265	300	168	1080	847	0	0	208	240	140	960	992	984
	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	9	0	212	240	168	1080	968	0	0	208	300	140	960	992	1107
	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11	0	212	300	210	1080	968	0	0	260	240	175	840	744	861
	12	0	265	300	168	1080	726	0	0	312	360	140	960	868	1045.5
DEFENSE	13	0	212	240	168	675	605	0	0	208	240	140	240	248	123
	14	0	212	180	126	0	0	0	0	156	180	105	0	0	0
	15	0	318	240	168	810	726	0	0	312	0	140	720	868	861
	16	0	318	300	210	0	0	0	0	260	240	140	0	0	0
	17	0	265	240	168	810	847	0	0	208	300	140	720	744	738
	18	0	318	420	252	945	847	0	0	312	360	175	840	744	861
	19	0	159	240	126	675	605	0	0	156	240	105	840	744	861
	20	0	265	300	210	945	1089	0	0	312	360	175	960	868	1107
GOALIES	21	0	212	240	126	945	0	0	0	156	240	105	600	868	738
	22	0	212	180	126	0	0	0	0	156	180	105	0	0	0
	23	0	318	360	252	0	847	0	0	260	360	140	0	0	0

Week		Week 3							Week 4						
Day		Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Date		17-Feb	18-Feb	19-Feb	20-Feb	21-Feb	22-Feb	23-Feb	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb	1-Mar	2-Mar
Seesion 1			Lift												
Session2		Off	Ice	Ice	Ice	Game	Game	Off	Off	Ice	Ice	Ice	Game	Off	Game
FORWARDS	1		425	300	210	1080	968			260	360	175	1065	1116	1107
	2		425	360		945	847			260	300	105	903	744	738
	3		425	300	126	945	847			208	300	140	903	744	984
	4		518	300	252	1080	847			260	300	140	1023	992	861
	5		372	240	126	405	121			156	240	140	183	124	123
	6		425	300	210	1080	968			260	300	140	903	868	
	7		425	300	168	1080	847			208	240	140	1023	992	984
	8														
	9		372	240	168	1080	968			208	300	140	1023	992	1107
	10														
	11		372	300	210	1080	968			260	240	175	903	744	861
	12		385	300	168	1080	726			312	360	140	1023	868	1045.5
DEFENSE	13		332	240	168	675	605			208	240	140	303	248	123
	14														
	15		438	240	168	810	726			312		140	804	868	861
	16		478	300	210					260	240	140	63		
	17		425	240	168	810	847			208	300	140	762	744	738
	18		518	420	252	945	847			312	360	175	924	744	861
	19		279	240	126	675	605			156	240	105	903	744	861
	20		465	300	210	945	1089			312	360	175	1044	868	1107
GOALIES	21		372	240	126	945				156	240	105	663	868	738
	22		372	180	126					156	180	105	63		
	23		478	360	252		847			260	360	140	63		
PTL			425	180	160	851.4	851.4			180	250	105	941.4	851.4	851.4

Attachment 5. sRPE Record Sheet Segmented by Position

				Planned				Team				Defense				Forwards				Goalies			
Week	Date	Day	Activity	RPE	D(min)	TL	PTL	RPE	D(min)	TL	ATL	RPE	D(min)	TL	ATL	RPE	D(min)	TL	ATL	RPE	D(min)	TL	ATL
	3-Feb	Mon	Off			0 0	0			0 0	0			0 0	0			0 0	0			0 0	0
	4-Feb	Tue	Ice Lift	8 5	60 40	480 200	680	6.3 4.5	58 40	365.4 180	545.4	5.83 4	58 40	338.14 40	378.14	6.55 4	58 40	379.9 160	539.9	4	58 40	0 160	160
	5-Feb	Wed	Ice	4	60	240 0	240	6.1	70	427 0	427	6	70	420 0	420	6.09	70	426.3 0	426.3	6.5	70	455 0	455
1	6-Feb	Thu	Ice	4	45	180 0	180	4.5	50	225 0	225	4.67	50	233.5 0	233.5	4.3	50	215 0	215	6	50	300 0	300
	7-Feb	Fri	Game	6.6	129	0 851.4	851.4	6.3	123	0 774.9	774.9	5.86	123	0 720.78	720.78	6.64	123	0 816.72	816.72	6	123	0 738	738
	8-Feb	Sat	Game	6.6	129	0 851.4	851.4	7.1	126	0 894.6	894.6	6.43	126	0 810.18	810.18	7.6	126	0 957.6	957.6	6	126	0 756	756
	9-Feb	Sun	Off			0 0	0			0 0	0			0 0	0			0 0	0			0 0	0
	10-Feb	Mon	Off			0 0	0			0 0	0			0 0	0			0 0	0			0 0	0
	11-Feb	Tue	lift	5	40	0 200	200	3.9	40	0 156	156	3.43	40	0 137.2	137.2	3.5	40	0 140	140	3.5	40	0 140	140
	12-Feb	Wed	Ice	5	60	300 0	300	6	78	468 0	468	5.5	78	429 0	429	6.63	78	517.14 0	517.14	4	78	312 0	312
2	13-Feb	Thu	Ice	4	45	180 0	180	4.4	55	242 0	242	4.5	55	247.5 0	247.5	4.3	55	236.5 0	236.5	4.33	55	238.15 0	238.15
	14-Feb	Fri	Game	6.6	129	0 851.4	851.4	6.1	123	750.3 0	750.3	6	123	738 0	738	6.4	123	787.2 0	787.2	4	123	492 0	492
	15-Feb	Sat	Game	6.6	129	0 851.4	851.4	6.4	123	787.2 0	787.2	6.17	123	758.91 0	758.91	6.6	123	811.8 0	811.8	6	123	738 0	738
	16-Feb	Sun	Ice	4	60	240 0	240	4.5	60	270 0	270	4.5	60	270 0	270	4.6	60	276 0	276	4.33	60	259.8 0	259.8

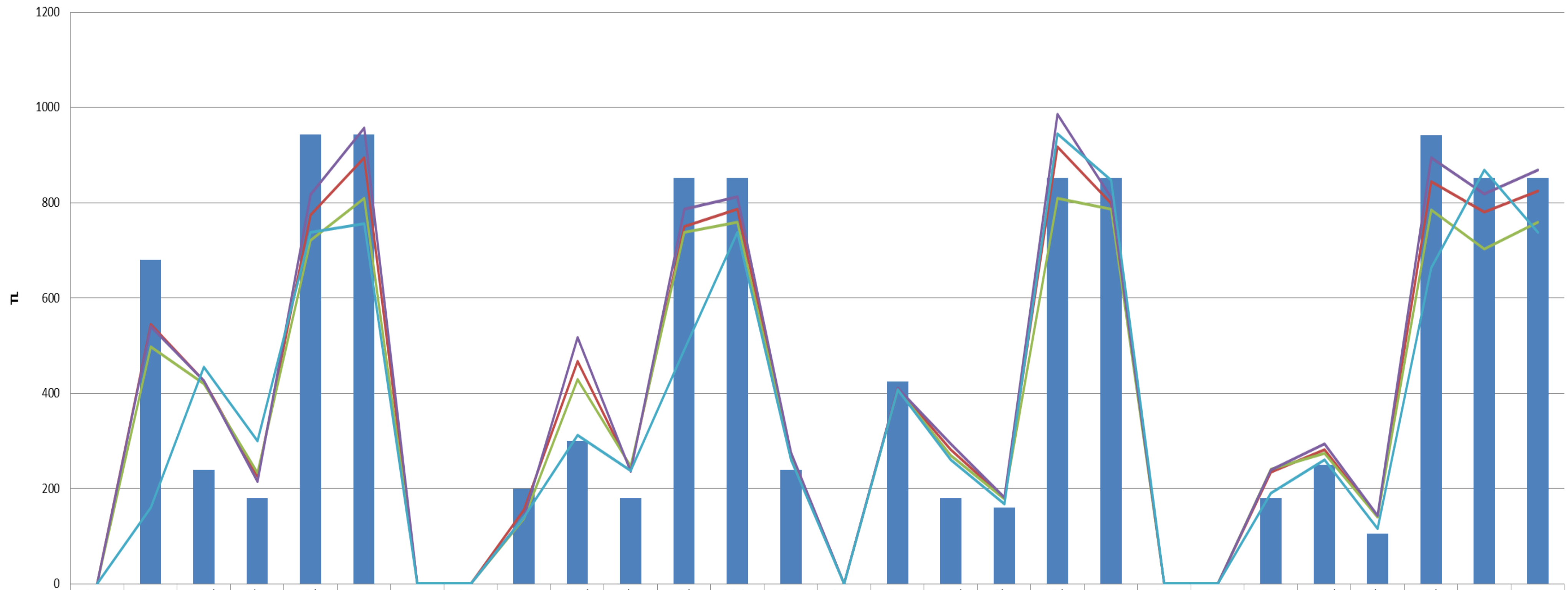
				Planned				Team				Defense				Forwards				Goalies			
Week	Date	Day	Activity	RPE	D(min)	TL	PTL	RPE	D(min)	TL	ATL	RPE	D(min)	TL	ATL	RPE	D(min)	TL	ATL	RPE	D(min)	TL	ATL
3	17-Feb	Mon	Off			0 0	0			0 0	0			0 0	0			0 0	0			0 0	0
	18-Feb	Tue	Ice Lift	5 5	45 40	225 200	425	4.8 3.9	53 40	254.4 156	410.4	4.88 3.75	53 40	258.64 150	408.64	4.8 3.9	53 40	254.4 156	410.4	4.67 4	53 40	247.51 160	407.51
	19-Feb	Wed	Ice	4	45	180 0	180	4.7	60	0 282	282	4.5	60	0 270	270	4.9	60	0 294	294	4.33	60	0 259.8	259.8
	20-Feb	Thu	Ice	4	40	160 0	160	4.3	42	0 180.6	180.6	4.25	42	0 178.5	178.5	4.33	42	0 181.86	181.86	4	42	0 168	168
	21-Feb	Fri	Game	6.6	129	0 851.4	851.4	6.8	135	0 918	918	6	135	0 810	810	7.3	135	0 985.5	985.5	7	135	0 945	945
	22-Feb	Sat	Game	6.6	129	0 851.4	851.4	6.6	121	0 798.6	798.6	6.5	121	0 786.5	786.5	6.7	121	0 810.7	810.7	7	121	0 847	847
	23-Feb	Sun	Off			0 0	0			0 0	0			0 0	0			0 0	0			0 0	0
4	24-Feb	Mon	Off			0 0	0			0 0	0			0 0	0			0 0	0			0 0	0
	25-Feb	Tue	Ice	4	45	180 0	180	4.5	52	234 0	234	4.63	52	240.76 0	240.76	4.6	52	239.2 0	239.2	3.67	52	190.84 0	190.84
	26-Feb	Wed	Ice	5	50	250 0	250	4.7	60	282 0	282	4.57	60	274.2 0	274.2	4.9	60	294 0	294	4.33	60	259.8 0	259.8
	27-Feb	Thu	Ice	3	35	105 0	105	4	35	140 0	140	4	35	140 0	140	4.1	35	143.5 0	143.5	3.33	35	116.55 0	116.55
	28-Feb	Fri	Preskate Game	3 6.6	30 129	90 851.4	941.4	3.1 6.5	21 120	65.1 780	845.1	3.13 6	21 120	65.73 720	785.73	3.2 6.9	21 120	67.2 828	895.2	3 5	21 120	63 600	663
	1-Mar	Sat	Game	6.6	129	0 851.4	851.4	6.3	124	0 781.2	781.2	5.67	124	0 703.08	703.08	6.6	124	0 818.4	818.4	7	124	0 868	868
	2-Mar	Sun	Game	6.6	129	0 851.4	851.4	6.7	123	0 824.1	824.1	6.17	123	0 758.91	758.91	7.06	123	0 868.38	868.38	6	123	0 738	738

Attachment 6. sRPE Record Sheet Segmented by Experience

				Planned				Freshmen				Sophmores				Juniors				Seniors			
Week	Date	Day	Activity	RPE	D(min)	TL	PTL	RPE	D(min)	TL	ATL	RPE	D(min)	TL	ATL	RPE	D(min)	TL	ATL	RPE	D(min)	TL	ATL
	3-Feb	Mon	Off			0 0	0			0 0	0			0 0	0			0 0	0			0 0	0
	4-Feb	Tue	Ice Lift	8 5	60 40	480 200	680	5.67 4.67	58 40	328.86 186.8	515.66	6.67 4.25	58 40	386.86 170	556.86	5.83 4.33	58 40	338.14 173.2	511.34	6.92 4.83	58 40	401.36 193.2	594.56
	5-Feb	Wed	Ice	4	60	240 0	240	6	70	420 0	420	6.25	70	437.5 0	437.5	5.4	70	378 0	378	6.5	70	455 0	455
1	6-Feb	Thu	Ice	4	45	180 0	180	4.75	50	237.5 0	237.5	4.25	50	212.5 0	212.5	4.25	50	212.5 0	212.5	4.67	50	233.5 0	233.5
	7-Feb	Fri	Game	6.6	129	0 851.4	851.4	5.86	123	0 720.78	720.78	7	123	0 861	861	6.5	123	0 799.5	799.5	6.4	123	0 787.2	787.2
	8-Feb	Sat	Game	6.6	129	0 851.4	851.4	6.43	126	0 810.18	810.18	7.33	126	0 923.58	923.58	6.83	126	0 860.58	860.58	7.8	126	0 982.8	982.8
	9-Feb	Sun	Off			0 0	0			0 0	0			0 0	0			0 0	0			0 0	0
	10-Feb	Mon	Off			0 0	0			0 0	0			0 0	0			0 0	0			0 0	0
	11-Feb	Tue	lift	5	40	0 200	200	4	40	0 160	160	3.75	40	0 150	150	3.6	40	0 144	144	4.2	40	0 168	168
	12-Feb	Wed	Ice	5	60	300 0	300	6.75	78	526.5 0	526.5	6.67	78	520.26 0	520.26	4.8	78	374.4 0	374.4	5.75	78	448.5 0	448.5
2	13-Feb	Thu	Ice	4	45	180 0	180	4.33	55	238.15 0	238.15	4	55	220 0	220	4.29	55	235.95 0	235.95	4.67	55	256.85 0	256.85
	14-Feb	Fri	Game	6.6	129	0 851.4	851.4	6.33	123	778.59 0	778.59	7.33	123	901.59 0	901.59	5.5	123	676.5 0	676.5	6	123	738 0	738
	15-Feb	Sat	Game	6.6	129	0 851.4	851.4	5.33	123	655.59 0	655.59	7.33	123	901.59 0	901.59	6.33	123	778.59 0	778.59	6.6	123	811.8 0	811.8
	16-Feb	Sun	Ice	4	60	240 0	240	4	60	240 0	240	4.75	60	285 0	285	4.29	60	257.4 0	257.4	4.83	60	289.8 0	289.8

				Planned				Freshmen				Sophmores				Juniors				Seniors			
Week	Date	Day	Activity	RPE	D(min)	TL	PTL	RPE	D(min)	TL	ATL	RPE	D(min)	TL	ATL	RPE	D(min)	TL	ATL	RPE	D(min)	TL	ATL
3	17-Feb	Mon	Off			0 0	0			0 0	0			0 0	0			0 0	0			0 0	0
	18-Feb	Tue	Ice Lift	5 5	45 40	225 200	425	5.25 4	53 40	278.25 160	438.25	4.75 3.75	53 40	251.75 150	401.75	4.57 3.71	53 40	242.21 148.4	390.61	4.83 4.17	53 40	255.99 166.8	422.79
	19-Feb	Wed	Ice	4	45	180 0	180	5.25	60	0 0	0	4.25	60	0 0	0	4.29	60	0 0	0	5	60	0 300	300
	20-Feb	Thu	Ice	4	40	160 0	160	4.5	42	0 0	0	4.25	42	0 0	0	3.5	42	0 0	0	4.83	42	0 202.86	202.86
	21-Feb	Fri	Game	6.6	129	0 851.4	851.4	6	135	0 810	810	7	135	0 945	945	6.5	135	0 877.5	877.5	7.6	135	0 1026	1026
	22-Feb	Sat	Game	6.6	129	0 851.4	851.4	4.67	121	0 565.07	565.07	7	121	0 847	847	6.71	121	0 811.91	811.91	8.25	121	0 998.25	998.25
	23-Feb	Sun	Off			0 0	0			0 0	0			0 0	0			0 0	0			0 0	0
4	24-Feb	Mon	Off			0 0	0			0 0	0			0 0	0			0 0	0			0 0	0
	25-Feb	Tue	Ice	4	45	180 0	180	5	52	260 0	260	4	52	208 0	208	4.14	52	215.28 0	215.28	4.83	52	251.16 0	251.16
	26-Feb	Wed	Ice	5	50	250 0	250	5	60	300 0	300	4	60	240 0	240	4.5	60	270 0	270	5.17	60	310.2 0	310.2
	27-Feb	Thu	Ice	3	35	105 0	105	4.25	35	148.75 0	148.75	3.75	35	131.25 0	131.25	3.57	35	124.95 0	124.95	4.33	35	151.55 0	151.55
	28-Feb	Fri	Preskate Game	3 6.6	30 129	90 851.4	941.4	3.25 5.33	21 120	68.25 639.6	707.85	2.75 6	21 120	57.75 720	777.75	3 6.83	21 120	63 819.6	882.6	3.5 7	21 120	73.5 840	913.5
	1-Mar	Sat	Game	6.6	129	0 851.4	851.4	4.67	124	0 579.08	579.08	6	124	0 744	744	6.5	124	0 806	806	7.2	124	0 892.8	892.8
	2-Mar	Sun	Game	6.6	129	0 851.4	851.4	5.5	123	0 676.5	676.5	5.33	123	0 655.59	655.59	7.17	123	0 881.91	881.91	7.75	123	0 953.25	953.25

Attachment 7. Variation in Daily TLs Segmented by Position



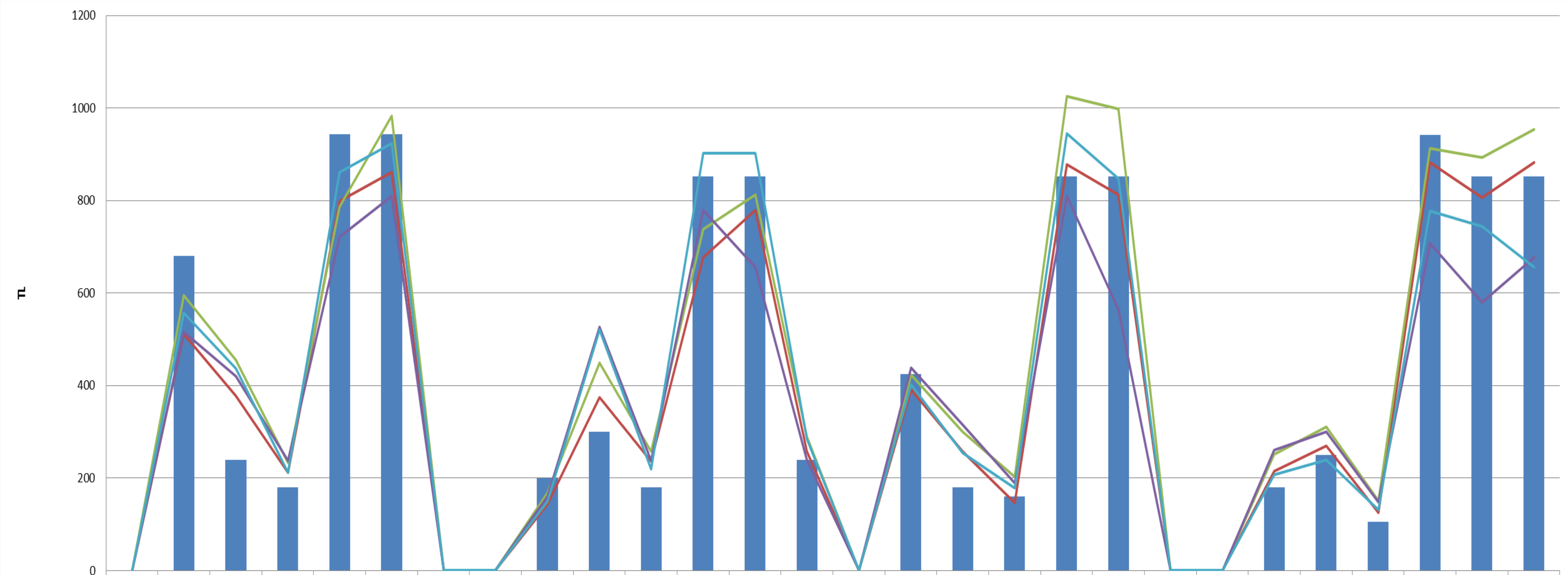
Week1	Mon 3-Feb Off	Tue 4-Feb Ice & Lift	Wed 5-Feb Ice	Thu 6-Feb Ice	Fri 7-Feb Game	Sat 8-Feb Game	Sun 9-Feb Off
PTL	0	680	240	180	943.8	943.8	0
Team	0	545.4	427	225	774.9	894.6	0
D	0	498.14	420	233.5	720.78	810.18	0
F	0	539.9	426.3	215	816.72	957.6	0
G	0	160	455	300	738	756	0

Week2	Mon 10-Feb Off	Tue 11-Feb Lift	Wed 12-Feb Ice	Thu 13-Feb Ice	Fri 14-Feb Game	Sat 15-Feb Game	Sun 16-Feb Ice
PTL	0	200	300	180	851.4	851.4	240
Team	0	156	468	242	750.3	787.2	270
D	0	137.2	429	247.5	738	758.91	270
F	0	140	517.14	236.5	787.2	811.8	276
G	0	140	312	238.15	492	738	259.8

Week3	Mon 17-Feb Off	Tue 18-Feb Ice & Lift	Wed 19-Feb Ice	Thu 20-Feb Ice	Fri 21-Feb Game	Sat 22-Feb Game	Sun 23-Feb Off
PTL	0	425	180	160	851.4	851.4	0
Team	0	410.4	282	180.6	918	798.6	0
D	0	408.64	270	178.5	810	786.5	0
F	0	410.4	294	181.86	985.5	810.7	0
G	0	407.51	259.8	168	945	847	0

Week4	Mon 24-Feb Off	Tue 25-Feb Ice	Wed 26-Feb Ice	Thu 27-Feb Ice	Fri 28-Feb Game & Pre-game Skate	Sat 1-Mar Game	Sun 2-Mar Game
PTL	0	180	250	105	941.4	851.4	851.4
Team	0	234	282	140	845.1	781.2	824.1
D	0	240.76	274.2	140	785.73	703.08	758.91
F	0	239.2	294	143.5	895.2	818.4	868.38
G	0	190.84	259.8	116.55	663	868	738

Attachment 8. Variation in Daily TL Segmented by Experience



	Week1							Week2							Week3							Week4						
	Mon 3-Feb Off	Tue 4-Feb Ice & Lift	Wed 5-Feb Ice	Thu 6-Feb Ice	Fri 7-Feb Game	Sat 8-Feb Game	Sun 9-Feb Off	Mon 10-Feb Off	Tue 11-Feb Lift	Wed 12-Feb Ice	Thu 13-Feb Ice	Fri 14-Feb Game	Sat 15-Feb Game	Sun 16-Feb Ice	Mon 17-Feb Off	Tue 18-Feb Ice & Lift	Wed 19-Feb Ice	Thu 20-Feb Ice	Fri 21-Feb Game	Sat 22-Feb Game	Sun 23-Feb Off	Mon 24-Feb Off	Tue 25-Feb Ice	Wed 26-Feb Ice	Thu 27-Feb Ice	Fri 28-Feb Game & Pre-game Skate	Sat 1-Mar Game	Sun 2-Mar Game
PTL	0	680	240	180	943.8	943.8	0	0	200	300	180	851.4	851.4	240	0	425	180	160	851.4	851.4	0	0	180	250	105	941.4	851.4	851.4
Junior	0	511.34	378	212.5	799.5	860.58	0	0	144	374.4	235.95	676.5	778.59	257.4	0	390.61	257.4	147	877.5	811.91	0	0	215.28	270	124.95	882.6	806	881.91
Senior	0	594.56	455	233.5	787.2	982.8	0	0	168	448.5	256.85	738	811.8	289.8	0	422.79	300	202.86	1026	998.25	0	0	251.16	310.2	151.55	913.5	892.8	953.25
Freshmen	0	515.66	420	237.5	720.78	810.18	0	0	160	526.5	238.15	778.59	655.59	240	0	438.25	315	189	810	565.07	0	0	260	300	148.75	707.85	579.08	676.5
Shophmore	0	556.86	437.5	212.5	861	923.58	0	0	150	520.26	220	901.59	901.59	285	0	401.75	255	178.5	945	847	0	0	208	240	131.25	777.75	744	655.59