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# An Examination of the Deliberate Practice Framework in Quad Rugby

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To the Graduate Council:

I am submitting herewith a thesis written by Rachel Lynn Boxell entitled "An Examination of the Deliberate Practice Framework in Quad Rugby." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Sport Studies.

Jeffrey T. Fairbrother, Major Professor

We have read this thesis and recommend its acceptance:

Gene Hayes, Lars Dzikus

Accepted for the Council:
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# AN EXAMINATION OF THE DELIBERATE PRACTICE FRAMEWORK IN QUAD RUGBY

A Thesis

Presented for

the Master of Science

Degree

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Rachel Lynn Boxell

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**Abstract**

Ericsson, Krampe, and Tesch-Römer (1993) forwarded a general framework to account for the characteristics and developmental experiences of individuals who have acquired exceptional performance in any domain. This framework proposed that experts undergo an extensive *acquisition period* involving the accumulation of thousands of hours of *deliberate practice* while overcoming various *constraints* that serve as functional barriers to the achievement of expertise. The purpose of this study was to examine expert disability-sport athletes to determine how well their experiences and characteristics were captured by Ericsson et al.'s (1993) framework. In Part I, quad rugby players recalled the amount of time spent in individual and team practice activities, quad rugby related activities, and daily life activities at the start of their career and every two years since. In Part II, these activities were rated with respect to relevance to improving performance, effort and concentration required, and enjoyment of participation. Findings revealed that quad rugby athletes engaged in similar amounts of practice throughout their career to those observed in superior performers across domains, including Ericsson et al.'s musicians and expert performers in the able-bodied sport domain (e.g., Helsen, Starkes, & Hodges, 1998). Contrary to the original deliberate practice framework as described by Ericsson et al. (1993), results indicated that disability-sport athletes did not rate the most relevant and effortful activities as low on enjoyment..

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# Chapter 1

# Introduction

## Background of the Study

### *General Framework of Expertise*

Superior performance, which exceeds either common or average performance, has been documented in a wide range of human performance domains (Ericsson & Smith, 1991). Although many people may attempt to reach such exceptional levels of performance, few have actually reached the highest levels of performance any given domain (Ericsson, 1996). Ericsson, Krampe, and Tesch-Römer (1993) forwarded a general framework to account for the characteristics and developmental experiences of individuals who have acquired exceptional performance in a given domain. This framework proposed that experts undergo an extensive *acquisition period* involving the accumulation of thousands of hours of *deliberate practice* while overcoming various *constraints* that serve as functional barriers to the achievement of expertise. (Henceforth, this framework will be referred to as the *deliberate practice framework*.)

The presence of an extended acquisition period prior to attaining expertise was originally documented by Simon and Chase (1973) in their examination of international grandmaster chess players. Exceptional performance in this domain appeared to require no less than 10 years of intense preparation. Acquisition periods of similar duration (from approximately 6,000 to 10,000 hours) have also been observed in international and top-level performers across a variety of other domains including the arts, sciences, and sports (Bloom, 1985; Ericsson & Crutcher, 1990; Hayes, 1981). Consistent with the extended acquisition period, several studies have also noted a positive correlation between the age at which an expert begins practice in their given domain and the level of performance ultimately achieved, with international level performers

typically showing the youngest starting ages (Ericsson, 1996; Ericsson & Crutcher, 1990; Ericsson et al., 1993). Ericsson and Crutcher (1990) reported that engagement in specific practice activities often begin before the age of six.

According to the deliberate practice framework, however, simply practicing for an extended period of time will not automatically result in the achievement of expertise in a domain (Ericsson et al., 1993). Rather, practice activities must fit the criteria for what has been termed deliberate practice. Deliberate practice consists of specifically designed activities focused on accomplishing targeted performance goals and improving skills. Consequently, deliberate practice as originally described does not include paid work, playful interaction, and observing others. Deliberate practice activities are intentionally designed to identify weaknesses and improve aspects of performance through observation of performance results and provision of relevant feedback regarding training goals (Ericsson et al., 1993). The deliberate practice framework places equal emphasis on both the quality and quantity of practice.

According to the deliberate practice framework, there is a linear relationship between the amount of practice accumulated and the level of performance attained. The so-called *monotonic benefits assumption* suggests that a person who has attained the highest level of performance in a domain will also have participated in the largest amount of time in deliberate practice. In fact, according to Ericsson et al. (1993), engagement in deliberate practice is the single most influential contributing factor in the achievement of expert performance in any domain.

During the acquisition period, developing experts must overcome three types of constraints that act to impede progress towards exceptional levels of performance (Ericsson et al., 1993). The *resource constraint* describes the necessity of acquiring access to resources such as teachers, training facilities, and training materials pertinent to the domain. Parents and

guardians often play an influential role in overcoming this constraint by providing financial support, transportation, and exposure to the domain. Because of the specialized nature of deliberate practice and the duration of the acquisition period, the resource constraint can place a considerable burden on the available time and money at the disposal of an aspiring expert's family. The *effort constraint* describes the necessity that an aspiring expert must be willing and capable of devoting the mental and physical effort to maximize each practice session. For many domains, practice can require intense effort that can only be maintained for a short period of time without leading to exhaustion. For example, Ericsson et al. (1993) reported that expert musicians could only engage in about four hours of deliberate practice activities each day. The *motivational constraint* describes the necessity that an aspiring expert must be motivated to dedicate the time and energy to practice activities that are not inherently enjoyable. Motivation is considered as essential for an aspiring expert to repeatedly produce performances of the highest quality when engaged in deliberate practice.

*Expertise in the Sport Domain*

A strong societal interest in professional and Olympic sport competition has led several researchers to examine how well the deliberate practice framework describes expertise in sports such as figure skating, wrestling, soccer, field hockey, martial arts, and middle distance running (Helsen, Starkes, & Hodges, 1998; Hodge & Deakin, 1998; Hodges & Starkes, 1996; Starkes, Deakin, Allard, Hodges, & Hayes, 1996; Young & Salmela, 2002). These studies have focused on documenting accumulated hours of deliberate practice and athletes' ratings of relevance, effort, concentration, and enjoyment of various practice activities as a way of exploring how constraints may have influenced their practice experiences. Although these studies have generally been consistent with Ericsson et al.'s (1993) examination of expert musicians, some

notable exceptions have also emerged. Similar findings include the duration of the acquisition period, age at which practice commenced, and accumulated hours of preparation time. In addition, participants in both music and sport studies have rated practice activities most closely matching actual domain performance demands as the most relevant aspects of practice.

Differences between the results found in the domains of music and sport have been related to the way activities are perceived and rated. Specifically, research in the sport domain has not supported Ericsson et al.'s (1993) contention that all deliberate practice activities would be rated high on relevance and effort, but low on inherent enjoyment. For example, in sports such as figure skating, wrestling, martial arts, soccer, field hockey, and middle distance running some practice activities have been rated as both highly relevant and enjoyable (Helsen et al., 1998; Hodge & Deakin, 1998; Hodges & Starkes, 1996; Starkes et al., 1996; Young & Salmela, 2002). Research in the sport domain has also found that participants rate concentration or cognitive effort as distinct from physical effort (e.g., Helsen et al., 1998; Starkes et al., 1996).

The divergent findings regarding enjoyment of deliberate practice activities has led some researchers in the sport domain to question if the original deliberate practice framework provides an adequate general description of expertise across domains (e.g., Starkes et al.,1996). Hodge and Deakin (1998) noted that "a working definition of deliberate practice has not been realized" and "the framework is in need of revisions if it is to transfer across domains" (p.277). In response to these observations, work in the sport domain has expanded the original deliberate practice framework to acknowledge that some practice activities can be both highly relevant and enjoyable (Young & Salmela, 2002).

*Sport Expertise and Disability-Sport Athletes*

Ericsson et al.'s (1993) deliberate practice framework has been characterized as consistent with the notion that anyone can become an expert by participating in an appropriate amount of deliberate practice (Janelle & Hillman, 2003). Indeed, there are several impressive examples of individuals with disabilities winning Olympic gold medals (Jokl, 1964). Ericsson et al. (1993) have suggested that the general nature of the effects of accumulated deliberate practice make it possible for a person with a disability to attain high levels of performance with sufficient practice. They further suggested that the generality of their deliberate practice framework would be supported by research demonstrating practice-driven improvements in performance regardless of the presence of a disability. In short, Ericsson et al. (1993) stated that, "…training can compensate for disabilities" (p.398).

Given this claim and the use of individual examples of athletes with disabilities winning Olympic gold medals to support the purported generalizability of the deliberate practice framework, it is somewhat surprising that so little research has been devoted to the relatively large number of individuals with disabilities who regularly participate in high levels of disability-sport competitions. If Ericsson et al.'s (1993) deliberate practice framework generalizes to the extent that specific training can compensate for a disability in venues such as the Olympics, then it also follows that the framework should describe the characteristics of expert athletes who participate in disability-sport competitions such as the Paralympics. On the other hand, because some of the characteristics of experts within the sport domain differ from those proposed in the original deliberate practice framework (e.g., perceived enjoyment of activities), it is also possible that the characteristics of experts in disability-sport will differ from those of able-bodied experts. Existing research on training in the disability-sport domain

(Hedrick, Morse, & Figoni, 1988; Watanabe, Cooper, Vosse, Baldini, & Robertson, 1992) has provided only a broad overview of training practices, so there is still a need to determine the extent to which the deliberate practice framework captures the characteristics and experiences of disability-sport athletes competing at the highest levels of competition.

An examination of expert disability-sport athletes might also provide additional insight into the roles that constraints play in the development and maintenance of expertise. In addition to the typical constraints that all aspiring expert athletes face, many disabled athletes must also cope with the constraints imposed by their disability. For example, these athletes may need specialized equipment, for both their sport participation and general use. The availability of training centers and qualified coaches is also likely to be reduced for disability-sport athletes compared to their able-bodied counterparts, requiring substantially greater travel demands and/or additional costs. Because daily routines related to personal care and transportation may require a substantial amount of time, some disability-sport athletes may face a limitation in accumulating hours of deliberate practice. The examination of expert disability-sport athletes will provide insight into theoretical issues related to the generalizability of the deliberate practice framework and the needs of an underserved population in pursuing high-level sports participation. Although the theoretical issues are the primary focus of this study, the practical implications are no less important. According to the International Paralympic Committee, sport participation by people with disabilities can help rehabilitate their physical bodies, integrate them into society, teach independence, and serve as a competitive and recreational outlet (International Paralympic Committee, 2009).

**Purpose**

The purpose of this study was to examine expert disability-sport athletes to determine how well their experiences and characteristics were captured by Ericsson et al.'s (1993) deliberate practice framework. Consistent with previous deliberate practice research, the primary focus of this study was on accumulated hours of deliberate practice and athlete ratings of relevance, effort, concentration, and enjoyment for selected practice and daily life activities.

**Research Questions**

*Research Question 1*. The first research question related to how well the deliberate practice framework accurately describes the accumulated hours of domain-specific practice for expert disability-sport athletes. In their original conceptualization of deliberate practice, Ericsson et al. (1993) argued that the achievement of expertise in any domain was preceded by the accumulation of the equivalent of at least 10,000 hours of practice (typically over the course of 10 or more years). This study documented the accumulated hours of practice for national and international level quad rugby players to see how closely their practice experiences matched the so-called "10 year rule". In addition, this study examined whether or not the accumulated amount of practice in quad rugby players was moderated by other factors such as the nature of an athlete's disability, time spent in non-practice activities, and experiences with other sports (both prior to and during their quad rugby career).

*Research Question 2.* The second research question addressed whether expert disability-sport athletes rated deliberate practice activities high on relevance and effort, but low on inherent enjoyment as observed by Ericsson et al. (1993) or high on all three dimensions as indicated by subsequent research in the sport domain (e.g., Helsen et al., 1998). In keeping with previous sport domain research, participants also rated activities with respect to the amount of

concentration required to distinguish between physical and mental effort (Helsen et al., 1998). This study documented ratings of various practice and non-practice activities that were given by national and international level quad rugby players. Ratings of non-practice activities were included to explore the possibility that constraints unique to disability-sport athletes' activities of daily living might influence their participation in and/or their ratings of deliberate practice activities for quad rugby.

**Assumptions**

This study is based upon the following assumptions:

1. All components of the questionnaire were clearly understood by participants.
2. All participants completed the survey and accurately recalled practice hours to the best of their ability.
3. All participants were honest and forthcoming.

**Limitations**

This study had the following limitations:

1. All participants were from a single quad rugby team.
2. The number of participants was 10.
3. The number of female ($n$ = 1) and male ($n$ = 9) participants were not equal in the sample.

**Delimitations**

This study had the following delimitations:

1. This study focused solely on disability-sport athletes.
2. Both longitudinal and cross-sectional data were collected using an instrument administered during a single session.

**Definition of Terms**

*Acquisition period.* Necessary preparation period for an aspiring expert to reach expertise. There is no absolute beginning point for the acquisition period across domains. It has been established that domain specific preparation consistently begins at a young age (e.g., 6 years) and superior performers engage in behaviors consistent with the accumulation of approximately 10,000 hours of deliberate practice (Bloom, 1985; Simon & Chase, 1983; Ericsson & Crutcher, 1990). Some research in the sport domain, however, has documented expert performance after the accumulation of as few as 6,000 hours (Helsen et al., 1998).

*Constraint.* A limitation or restraint that serves as a barrier to the aspiring expert's progress and which must be overcome to ultimately achieve expertise. Constraints include: resource, motivation, and effort (Ericsson et al., 1993).

*Deliberate practice.* Highly structured activity, that requires effort, is not inherently enjoyable, and generates no immediate rewards and generates cost due to accessing teachers and training environments (Ericsson et al., 1993).

*Disability-sport.* A term used to encompass competitive sports designed and practiced by persons with disabilities (DePauw & Gavron, 2005). Thus, disability-sport athletes are those who participate in a competitive disability-sport venue.

*Concentration.* A dimension of the effort constraint that was added by researchers in the sport domain to capture mental effort as a distinct dimension from the physical effort that was examined in previous studies (e.g., Ericsson et al., 1993; Helsen et al., 1998).

*Effort constraint.* This is one of three constraints proposed by Ericsson et al. (1993) that aspiring experts must overcome. Aspiring experts must engage in effortful practice activity, which must be sustained for an adequate amount time each day without leading to exhaustion.

One must overcome the effort constraint by continually giving maximal effort during practice throughout the entire acquisition period leading to superior performance. Research in the sport domain has expanded this constraint to distinguish between physical effort and mental effort, the latter of which is labeled as concentration (e.g., Helsen et al., 1998).

*Expert.* Experts are commonly defined as those who compete at international and/or national levels (e.g. Helsen et al., 1998; Young & Salmela, 2002). Experts in this study were defined as national- and/or international-level quad rugby athletes participating as members of a team sanctioned by the United States Quad Rugby Association (USQRA).

*Inherent enjoyment.* This term describes participation for the sake of enjoying participation. According to the original deliberate practice framework, experts do not experience inherent enjoyment during practice but are motivated to practice as a means of improving performance (Ericsson et al., 1993). Research on expertise in the sport domain has reported that expert athletes do experience inherent enjoyment during practice (e.g., Starkes et al., 1996).

*Monotonic benefits assumption.* The amount of time an individual is engaged in deliberate practice activities is monotonically related to that individual's level of acquired performance (Ericsson et al., 1993). This assumption indicates that the highest levels of expertise are achieved by those who have engaged in deliberate practice for the longest amount of time.

*Motivational constraint.* This is one of three constraints proposed by Ericsson et al. (1993) that aspiring experts must overcome. Aspiring experts must be motivated to dedicate the time and energy to practice activities that are not inherently enjoyable and to repeatedly produce performances of the highest quality on a consistent basis throughout their entire training and performance career.

*National level quad rugby*. National level quad rugby in the United States is organized through the United States Quad Rugby Association (USQRA). The USQRA hosts a national championship tournament each year, awarding one team the title of national champion. The quad rugby season includes competition against international teams (e.g., Germany and Canada) that come to the United States to compete in tournaments.

*Quad ruby*. Quad rugby is a disability-sport played by persons who have upper- and lower-extremity impairments. Please see Appendix A for further explanation of the sport.

*Quad rugby activities*. Activity definitions are outlined in the survey. Please see Appendix B for further explanation of activity terms and definitions.

*Quad rugby classification*. Players are classified into one of seven categories, from .5 (greatest impairment) to 3.5 (least impairment), based upon their functional impairment.

*Relevance*. Relevance and importance have been used interchangeably to refer to the same concept. When participants were asked to rate activities on relevance, it was defined by those activities that are relevant to improving their performance (see survey instructions in Appendix D).

*Resource constraint.* This is one of three constraints proposed by Ericsson et al. (1993) that aspiring experts must overcome. Aspiring experts must gain access to essential resources such as teachers, training materials, and training facilities. Parents and guardians often play a major role in overcoming this constraint by providing financial support, transportation, and exposure to the domain.

## Chapter 2

## Literature Review

Superior performance has been observed in a wide range of human performance domains (Ericsson & Smith, 1991), including chess (Simon & Chase, 1973), music (Bloom, 1985; Ericsson et al., 1993), and sport (Hodges & Starkes, 1996; Starkes et al., 1996). The original research on superior performance led to the proposal of a general framework of expertise (Ericsson et al., 1993), which attempts to explain the characteristics and developmental experiences of individuals who have acquired exceptional performance or knowledge in a given domain. This framework has been forwarded as general and applicable to a variety of domains. Despite previous research on the general framework of expertise in the sport domain, application to the domain of disability-sport has yet to be explored. It is currently unknown whether or not expert disability-sport athletes share important characteristics and experiences with their able-bodied counterparts.

### *General Framework for Expertise*

Ericsson et al. (1993) defined superior performance by establishing a theoretical framework for expertise that purportedly generalizes across all domains. This theoretical framework suggested that physical and anatomical differences that are often linked to genetic predisposition may in fact be a result of physiological adaptations due to intense training over an extended period of time. In characterizing those who have attained superior levels of performance Ericsson et al. (1993) forwarded what has become known as the deliberate practice framework, which argues that experts undergo an extensive acquisition period involving the accumulation of thousands of hours of deliberate practice while overcoming various constraints that serve as functional barriers to the achievements of expertise. Although the framework was

largely based on research that examined expert musicians (i.e., violinists and pianists), the authors argued that it also fit previous examinations of chess grandmasters and other experts in a variety of domains.

*Acquisition period*

According to the deliberate practice framework, experts undergo extensive training throughout a period known as the acquisition period. The acquisition period is the time frame of preparation necessary to attain superior performance. Characteristics of the acquisition period include the age of initiation and accumulated duration of time in training to reach expertise. A person striving to reach expertise will traverse through basic phases in their progress to reach top levels of performance.

The duration of time one spends practicing in a given domain is a characteristic observed in the acquisition of expert performance. Research has shown that international experts in a variety of domains have accumulated approximately 10,000 hours of deliberate practice over the course of at least 10 years (e.g., Simon & Chase, 1973; Ericsson et al., 1993). Simon and Chase (1973) observed that no international grand master chess players had acquired international performance with less than 10 years of experience. Hayes (1981) supported the 10-year rule as a necessary component in superior music composition. Ericsson and colleagues confirmed the requirement of 10 years of intense preparation as an essential characteristic in attaining the highest levels of performance for musicians and across domains (Ericsson, 1996; Ericsson et al., 1993). The 10-year rule has been widely adopted as a descriptive term by expertise researchers, but it should be noted that the number of years and accumulated practice hours typically varies across studies.

During the acquisition period, aspiring experts pass through several developmental phases (Bloom, 1985; Cote, 1999; Ericsson, 1996; Ericsson, Krampe, & Heizmann, 1993; Ericsson et al., 1993). Bloom (1985) described the transition to expert as occurring in three phases. During Phase I, children are introduced to the domain and engage in playful activities. As their interest level increases and ostensible "promise" or "talent" is recognized by parents or guardians, children enter Phase II and begin highly structured lessons. Phase III begins with a commitment to full-time involvement in the domain that includes a personal commitment to reach the highest level of performance possible. Aspiring experts increase the amount of time spent in practice during this stage and also seek out the most qualified coaches and most effective training resources. Once development to the status of expert is complete, a final phase can be achieved by a very limited number of experts (Ericsson et al., 1993). This phase, sometimes called *eminence*, involves the period of time when the established expert pushes performance above and beyond what has already been accomplished in the domain, thereby making a unique contribution to the development of the domain as a whole.

Cote (1999) examined the development of expertise in the sport domain and identified three stages, called the sampling years (6-12 years), the specializing years (13-15 years), and the investment years (16+ years). The age ranges for each stage show a progression from child age participation to young adult age participation and are established as the typical age ranges of expertise development in sport. The stages encompass a progression from *free play* to *deliberate play* to *structured practice* and then to deliberate practice (Cote, Baker, & Abernethy, 2003). *Free play* in sport-like activities occurs early in childhood and focuses only on inherent enjoyment and immediate gratification and occurs during the sampling years. *Deliberate play* occurs when a child engages in structured rule-driven games that are monitored by other children

or participating adults, but still has a primary focus on having fun, receiving immediate gratification, and completing activities that are inherently enjoyable (occurring during specializing years). *Structured practice* involves activities of organized sports that include a goal to improve performance (occurring during investment years). This type of practice is monitored, performance is corrected, and enjoyment is primarily extrinsic. Deliberate practice involves specifically designed activities with the primary goal of performance improvement.

The beginning of the acquisition period typically occurs at a young age in all domains. For example, the sampling years described by Cote (1999) begin at about age six when a child is first introduced to sport-like activities. Similarly, Ericsson and Crutcher (1990) reported that engagement in specific practice activities begin at a young age for international-level performers in a variety of domains, often before the age of six. During the acquisition period, a performer typically completes physical maturation and attains peak performance. The time at which physical maturation and peak performance are attained differ across and within domains. Ericsson (1996) noted that for non-vigorous domains (e.g., chess), peak performance is often attained a decade after the completion of physical maturation. For vigorous sport activities, peak performance is attained approximately 5 years after maturation. Age of achievement of superior performance for chess is often observed in the 30's while superior performance in vigorous sports is often seen in the 20's (Lehman, 1953; Schulz & Curnow, 1998).

*Deliberate practice*

In presenting their framework for attaining superior performance, Ericsson et al. (1993) emphasized that merely practicing for an extended period of time is not sufficient for the achievement of expertise in a domain if the quality of practice is not appropriate. For practice activities to effectively improve performance, they must fit the criteria for what has been termed

deliberate practice. Deliberate practice includes a set of characteristics that are different from engaging in everyday activities, in which learning may be an indirect result. Engaging in everyday activities is not done with the primary purpose of improving performance (Ericsson et al., 1993). Deliberate practice consists of specifically designed activities focused on accomplishing targeted performance goals and improving skills. Such activities should be rated by participants as highly relevant to domain performance, effortful, and not inherently enjoyable. Deliberate practice activities are designed to identify weaknesses and improve aspects of performance through feedback and observation of results. Consequently, deliberate practice does not include paid work, playful interaction, and observing others. Paid work activities are motivated by external rewards and pay for services. Monetary rewards are not immediate when engaging in deliberate practice, and more often, participating in deliberate practice may require monetary commitments to necessary resources. Playful interaction activities are enjoyable and do not have a specific goal. Observation of others does not require the necessary engagement in the given domain to improve performance. Deliberate practice is unique in its characteristics from other types of practice and it is identified as the single most influential contributing factor to the achievement of superior performance (Ericsson et al., 1993).

Ericsson et al. (1993) maintained that benefits accrued through the engagement in activities that qualify as deliberate practice are related to the so-called *monotonic benefits assumption.* This assumption stipulates that the attained level of performance is directly related to the accumulated amount of deliberate practice. More time devoted to deliberate practice results in the achievement of higher levels of performance. Thus, Ericsson et al. (1993) argued that aspiring experts must maximize the amount of time they spend engaged in deliberate practice. Maximizing of the amount of time devoted to deliberate practice, however, can often

be challenging, especially when considering the lengthy duration of the acquisition period and the presence of other constraints that act as barriers to participation in such practice.

*Constraints*

According to the deliberate practice framework, three types of constraints act to impede progress towards exceptional levels of performance during the acquisition period (Ericsson et al., 1993). The resource constraint relates to the necessity of acquiring access to resources such as teachers, training facilities, and training materials pertinent to the domain. Parents and guardians often play an influential role in overcoming this constraint by providing financial support, transportation, and exposure to the domain. Due to the specialized nature of deliberate practice and the duration of the acquisition period, the resource constraint can place a considerable burden on the available time and money of an aspiring expert's family. According to both Bloom (1985) and Cote (1999), young aspiring experts have at least one person in their life that commits time and financial means to facilitate the pursuit of perceived talent in a domain. Early in the acquisition period, aspiring experts are heavily dependent on a parent or guardian to provide financial, logistical, and emotional support.

The effort constraint relates to the necessity of an aspiring expert to be willing and capable of devoting the mental and physical effort to maximize each practice session. An hour or less may be committed by a child when first beginning practice in a given domain (Bloom, 1985). With increasing investment, however, the amount of time devoted to practice typically increases. In some domains, practice can require such intense effort that it can only be maintained for a short period of time without leading to exhaustion. For example, Ericsson et al. (1993) reported that musicians could only practice for about four hours each day. Exceptional performers must also be able to effectively manage recovery periods. This is particularly true in

sports requiring physical adaptation to increasing training demands. Improved performance can only be obtained with the correct balance of effort and recovery (Ericsson et al., 1993). Inadequate recovery leads to overtraining and symptoms of physical fatigue, muscular soreness, and lack of enthusiasm (Silva, 1990), all of which may act to limit deliberate practice.

The motivation constraint relates to the necessity that an aspiring expert must be willing to dedicate the time and energy to practice activities that are not inherently enjoyable. Bloom (1985) reported that parents play a role in fostering early motivation and conveying to their child that development requires practice. For the most part, however, an aspiring expert must be intrinsically motivated to repeatedly produce performances of the highest quality during the entire acquisition period.

*Deliberate Practice Framework and the Music Domain*

To document the acquisition period as a developmental characteristic of those achieving superior performance, Ericsson et al. (1993) interviewed musicians using retrospective recall methods. Participants were asked to provide detailed accounts of practice throughout their career. Results were consistent with the 10-year rule and monotonic benefits assumption. For violinists, systematic practice lessons began at age 8 and by age 20 the top performers had acquired over 10,000 hours of deliberate practice. Intermediate-level and the least accomplished performers had acquired 8,000 and 5,000 deliberate practice hours, respectively. For pianists, the average starting age for beginning practice with instruction was 5.8 years and 9.9 years for experts and amateurs, respectively. In addition, the average amount of practice per year increased with time for the experts but not the amateurs.

Ericsson et al. (1993) also asked musicians to rate activities in terms of relevance, effort, and enjoyment. The relevance ratings addressed how important the participants felt each activity

was in the development of their expertise. The effort ratings addressed how much effort the participants felt was required to perform each activity. The enjoyment ratings addressed the degree to which the participants felt participation in each activity was inherently enjoyable without consideration for the possible consequences of the activity. Rated activities included both everyday activities and musical activities. Examples of everyday activities included: household chores, work, sleep, body/health care, leisure activities, and education. Examples of musical activities included practice alone, practice with others, taking lessons, giving lessons, listening to music, and organization and preparation.

The ratings results indicated that deliberate practice included music related activities that were, "judged as most relevant for improvement of performance, effortful, and less inherently enjoyable than leisure and several other music-related activities" (Ericsson et al., 1993, p. 389). The results also revealed that musicians felt that practicing alone was the most relevant activity for improving performance, was effortful, and not inherently enjoyable. Taking violin lessons and engaging in solo performances were rated as the next most relevant activities. The only activity that was found to be highly enjoyable, highly relevant, and effortful was group performance.

*Deliberate Practice Framework and the Sport Domain*

A strong societal interest in professional and Olympic sport competition has led researchers to examine expertise in the sport domain. Several researchers have questioned how accurately Ericsson et al.'s (1993) deliberate practice framework describes expertise in individual and team sports (Helsen et al., 1998; Hodge & Deakin, 1998; Hodges & Starkes, 1996; Starkes, Deakin, Allard, Hodges, & Hayes, 1996; Young & Salmela, 2002). Sport domain studies have used similar research methods to those employed by Ericsson et al. (1993),

requiring participants to retrospectively recall the amount of time spent in practice during their entire acquisition period and rate specific practice and everyday activities in terms of relevance, effort, and enjoyment. In some studies, sport domain researchers have added a dimension called concentration to distinguish between mental and physical effort (e.g., Helsen et al., 1998).

*Individual sports*

Examinations of the deliberate practice framework as it applies to individual sports have been completed using sports including figure skating, wrestling, martial arts, and middle distance running (Hodge & Deakin, 1998; Hodges & Starkes, 1996; Starkes et al., 1996; Young & Salmela, 2002). For each of these sports, results revealed a positive relationship between the accumulated amount practice and the level of performance achieved by participants. For example, figure skaters and wrestlers averaged 16 years and 12 years of accumulated practice, respectively, prior to their career peaks. Figure skaters began practice at about age 5, private lessons at age 7, skating year-round at age 10, and reached their peak at about age 21. Wrestlers began practice at about age 13, engaged in systematic practice at age 15, and reached their peak at about age 25. Ten years after practice was initiated, international-level wrestlers had accumulated amounts of practice comparable to those accumulated by the best violinists in Ericsson et al.'s (1993) study (Hodges & Starkes, 1996). In martial arts, both experts and novices spent a similar amount of time engaged in all karate-related activities at the beginning of the acquisition period. From the first year onward, however, athletes who eventually reached the black belt level reported a steady increase in the amount of time they devoted to highly relevant activities (Hodge & Deakin, 1998).

*Team sports*

The first examination of the deliberate practice framework as it applies to team sports involved the sports of soccer and field hockey (Helsen et al., 1998). This study distinguished between practice activities that were completed individually or as a team. Team practice activities were those that involved individual athletes working together toward a common goal. Results for accumulated amount of practice were consistent with the monotonic benefits assumption. International-level soccer players accumulated larger amounts of individual practice across their career than provincial-level players and international-level field hockey players' accumulated larger amounts of individual practice than national- and provincial-level players. Both international- and national-level players spent more time in team practice than provincial-level players with increased commitments at nine years of age for international-level soccer and field hockey players.

Activities that soccer and field hockey players judged as most relevant were also judged as most enjoyable as observed in individual sports. Concentration was also distinguished from the effort dimension. Mental rehearsal and working alone with a coach were rated high on relevance and concentration where as physically demanding activities such as running and weight training were rated high on effort and not concentration.

*Sport domain contributions to the deliberate practice framework*

Research in the sport domain has produced a number of findings consistent with Ericsson et al.'s (1993) argument that the deliberate practice framework offers a general description of expertise in any domain. For example, sport domain research has consistently found no differences between international-, national-, and provincial-level performers' ratings of practice activities in terms of their relevance, concentration, effort, and enjoyment (e.g., Young &

Salmela, 2002), which mirrors the previous research on musicians. Research in the music and sport domains has also reported that participants rate activities that are most closely related to the actual performance demands of competition as most relevant to the development of their expertise (Ericsson et al., 1993; Hodge & Deakin, 1998; Hodges & Starkes, 1996; Starkes et al., 1996; Young & Salmela, 2002). Musicians rated practicing alone and lessons as the most relevant practice activity (Ericsson et al., 1993). Figure skaters rated lessons with a coach and on-ice training as most relevant (Starkes et al., 1996). Wrestler's rated mat work and working with a coach as the two most relevant components of practice (Hodges & Starkes, 1996). Martial arts performers rated taking classes and kata training with others the most relevant activities (Hodge & Deakin, 1998). Middle distance runners rated all activities that actually involved running, including easy runs, hard runs, interval runs, and racing as the most relevant activities (Young & Salmela, 2002).

Another finding in the sport domain that has been consistent with the deliberate practice framework is that several activities considered highly relevant to performance have also been rated as requiring high levels of concentration (Helsen et al., 1998; Hodge & Deakin, 1998; Hodges & Starkes, 1996; Starkes et al., 1996). For example, skaters rated on-ice training and wrestlers rated mat work as requiring high concentration (Hodges & Starkes, 1996; Starkes et al., 1996). Although the musicians rated activities with respect to effort but not concentration, per se, Ericsson et al.'s (1993) use of the term *effort* was more consistent with concentration than physical effort. Findings in field hockey and soccer indicated that athletes can distinguish concentration as a separate dimension from physical effort (Helsen et al., 1998). Specifically, activities such as mental rehearsal which require little or no physical effort received high rankings for concentration. Ratings of high relevancy and concentration have been found for

mental rehearsal and/or working alone with a coach by athletes in figure skating, wrestling, soccer, and field hockey (Helsen et al., 1998; Hodges & Starkes, 1996; Starkes et al., 1996).

Ericsson et al.'s (1993) stipulation that deliberate practice activities be rated high on relevance and effort but low on inherent enjoyment has become a central point in efforts to define what constitutes deliberate practice in the sport domain. In the sports of figure skating, wresting, martial arts, soccer, field hockey, and middle distance running, several activities rated as highly relevant have also been rated as highly enjoyable. For example, working with a coach and mat work for the wrestlers and on-ice training for skaters received high ratings for both relevance and enjoyment (Hodges & Starkes, 1996; Starkes et al., 1996). For martial arts, sparring, group classes, kata training with others, kata training alone, and impact training received high ratings for relevance, concentration, effort, and enjoyment. For middle distance runners, speed work and time trials received high ratings for relevance and enjoyment (Young & Salmela, 2002). For soccer, games and tactical training as well as work on technical skills received high ratings for relevance, concentration, and enjoyment. For field hockey, games, exhibition games, technical skill work as a team, and individual work on technical skills received high ratings for relevance, concentration, and enjoyment (Helsen et al., 1998).

Every study in the sport domain has revealed high enjoyment ratings for at least some activities that otherwise fit Ericsson et al.'s (1993) strict description of deliberate practice (i.e., rated as highly relevant and requiring high effort). These findings along with the finding that participants distinguish between physical effort and concentration have led researchers in the sport domain to propose a modified conceptualization of deliberate practice, herein called the sport-specific deliberate practice framework (Helsen et al., 1998; Hodges & Starkes, 1996; Young & Salmela, 2002). Thus, much of the research on deliberate practice in the sport domain

has assessed relevance, effort, concentration, and enjoyment of practice activities. In addition, it has been proposed that deliberate practice in the sport domain consists of "practice that is highly relevant for improving performance requires great amounts of concentration and effort, and which includes activities in which participation is seemingly enjoyable" (Young & Salmela, 2002, p.169).

*Deliberate Practice Framework and the Disability-Sport Domain*

Despite the previous research in the sport domain, application of the deliberate practice framework to the domain of disability-sport has yet to be explored. It is currently unknown if the experiences and characteristics of expert disability-sport athletes can be captured by a sport-specific deliberate practice framework similar to the one that has emerged from research on able-bodied athletes. Ericsson et al.'s (1993) original deliberate practice framework has been interpreted to imply that anyone can become an expert by participating in an appropriate amount of deliberate practice (Janelle & Hillman, 2003). Indeed, there are several impressive examples of individuals with disabilities winning Olympic gold medals (Jokl, 1964). For example, Harold Connolly of the United States who had paralyses of muscles in the left arm was a 1956 Olympic gold medalist and considered the greatest hammer thrower of his time. Karoly Takacs of Hungary, was considered the worlds best marksman (pistol shooting) for more than a quarter of a century, and won Olympic gold medals in 1948 and 1952. Takacs was a trained marksman when he lost his right arm in an accident, which forced him to learn to shoot with his left hand. Ericsson et al. (1993) stated that "training can compensate for disabilities" (p.398) and further suggested that the generalizability of their deliberate practice framework would be supported by research demonstrating performance improvements as a result of systematic practice regardless of disability.

Given that individual examples of athletes overcoming disabilities to win Olympic gold medals have been used to support the general nature of the deliberate practice framework, it is somewhat surprising that so little research has been devoted to the relatively large number of disabled individuals who regularly participate in high levels of disability-sport competitions. Two research studies have examined training practices for wheelchair athletes. Both of these studies preceded the publication of Ericsson et al.'s (1993) study, so they did not examine disability-sport from the perspective of the deliberate practice framework. Nevertheless, they do provide informative background information that is relevant to the focus of the present study.

Hedrick, Morse, & Figoni (1988) and Watanabe, Cooper, Vosse, Baldini, & Robertson (1992) examined the training practices of expert wheelchair road racers and athletes who participated in the National Wheelchair Athletic Association training camps, respectively. The latter study included the sports of track and field, weight lifting, swimming, table tennis, archery, and shooting. Participants in these studies provided demographic information (e.g., age, weight, nature and level of disability, and racing experience) and accounts of their training practices. The information regarding training practices included the numbers of workouts per week, miles per week, and weight training sessions per week, as well as the number of hours per workout, the percent of time spent on speed work or interval training per week, and the number of competitions per quarter. Hedrick et al. (1988) also reported other supplemental physical activities that participants pursued at least twice per week. A number of findings from these two studies were relevant to the current study, particularly those related to the acquisition period, weekly training behaviors, and primary sources of training information.

Certain features of the acquisition period for the athletes in Hedrick et al. (1988) and Watanabe et al. (1992) differed from those seen in the research that has examined the deliberate

practice framework in sports and music. For example, the average age at which participants began participation was well into early adulthood. The average disability-sport starting age was 24 and 26 for Hedrick et al. (1988) and Watanabe et al. (1992), respectively. In addition, expert wheelchair racers averaged only six years of experience in their domain (Hedrick et al., 1988) and the participants in Watanabe et al. (1992), which included a range of different sports, averaged about seven years of experience. It is likely that these averages were influenced by the fact that the average age of participants was 31 years and the average length of time they had been disabled was just under 17 years.

Information regarding weekly training procedures revealed that participants did not engage in quantities of weekly practice that would be consistent with the eventual accumulation of 10,000 hours over the course of 10 years. Hedrick et al. (1998) reported averages of 6.6 and 5.7 days of training per week for men and women, respectively, with sessions that averaged no more than 80 minutes. Watanabe et al. (1992) reported that participants at the National Wheelchair Association training camp averaged about four workouts per week, with sessions that averaged just over two hours. When extrapolated to 10 years, these reported averages yield less than 5,000 hours of accumulated practice.

Information about the primary sources of training information used by disability-sport athletes revealed both similarities and differences with the research in the music and able-bodied sport domains. Watanabe et al. (1992) reported that coaches and trainers were the primary sources of training information, followed by other athletes, personal experience, and training camps/workshops/conferences. This was consistent with the deliberate practice research indicating that figure skaters, wrestlers, and musicians rated coaches as a very relevant to their training (Ericsson et al., 1993; Hodges & Starkes, 1996; Starkes et al., 1996). In contrast,

Hedrick et al. (1988) reported that coaches were not the primary source of training information for expert wheelchair road racers. Other athletes were ranked as the primary source of information. Coaches were ranked second by men and third by women.

Another finding that was unique to disability-sport was that a number of participants were either multi-sport athletes or devoted substantial time to other activities. Hedrick et al. (1988) reported that three female participants were multi-sport athletes. In addition, seventy percent of all female participants reported engaging in other activities unrelated to wheelchair racing (e.g., tennis, basketball, and racquetball). Thirty-five percent of male participants reported involvement in other activities.

*Barriers in disability-sport*

As previously discussed, the presence of constraints acting to limit the training activities of aspiring experts is a fundamental component of Ericsson et al.'s (1993) deliberate practice framework. Disability-sport athletes face the same constraints as their able-bodied counterparts, but also face additional potential barriers because of the nature of their disabilities. Some of these barriers are socially imposed conventions that have limited access to opportunities, including those related to sport participation, that are widely available to able-bodied persons (DePauw & Gavron, 2005). Others stem from the fact that any given disability can act to magnify the normal constraints faced by an able-bodied person. For example, the resource constraint is logically greater for disability-sport athletes than for their able-bodied counterparts because appropriate sport programs, specialized equipment, and facilities are typically less accessible to persons with disabilities. Access to qualified coaches also represents a unique challenge for disability-sport athletes. In fact, until the 1990s many disability-sport athletes were

self-coached and it was not until after this point the disability-sport domain began to see increasing opportunities for participation (DePauw & Gavron, 1991).

Further research on expert disability-sport athletes is needed for both theoretical and practical reasons. The continued growth of high-level disability-sport competitions such as the Paralympics has created a need to better understand the characteristics and experiences of successful disability-sport athletes. This information can then be used to advance current training practices to better support the development of future athletes. The disability-sport domain also offers a promising opportunity to examine the generalizability of the original and sport-specific deliberate practice frameworks. Finally, because sport participation can play an important role in the physical rehabilitation, social integration, and enhancement of life quality of persons with disabilities, research in this area will be useful in future efforts to address the needs of this underserved population (International Paralympic Committee, 2009).

# Chapter 3

## Methods

### Participants

Participants in this study were nine men and one woman ($N$ = 10), all at least 18 years of age, who had a disability but were otherwise apparently healthy. All participants had the ability to give voluntary and informed consent (see Appendix C for the University of Tennessee IRB Form A and Informed Consent document). Participants were recruited from a pool of 12 quad rugby players currently on the Lakeshore Foundation *Demolition* team located in Birmingham, AL., which competes as part of the United States Quad Rugby Association. The team has won several national championships and selected members have competed internationally on the U.S. National Team (Lakeshore Foundation, 2009). Recruiting was accomplished through personal contact.

### Instrument

This study consisted of a single one-on-one session in which participants were asked to complete a written survey. Accommodations were available for any participants who could not complete the survey as designed (e.g., those with difficulty writing due to their disability). This accommodation was provided by the investigator. Prior to conducting the survey, the coach of the *Demolition,* verified that all potential participants had the cognitive capacity to answer the questions on the survey, although many required help with writing. A copy of the survey can be found in Appendix D.

Part I of the survey requested biographical information concerning the age when practice was first initiated, the highest level attained in quad rugby, success in competitions, and the nature of the participant's disability. Participants estimated the number of minutes devoted to

various practice and life activities during a "typical week" for two-year intervals since beginning their quad rugby career. Participants were allowed to refer to any personal training logs they brought with them. If participants had competitive experience in other sports, they were asked to provide information for those sports as well.

Part II of the survey required participants to rate various practice and daily life activities on four dimensions related to the deliberate practice framework: relevance to improving quad rugby performance; physical effort required; inherent enjoyment; and concentration (i.e., mental effort) required. Each activity was rated with respect to the four dimensions using a scale of 0 to 10, with 0 being low and 10 being high. Activities were separated into four categories: individual practice activities, team practice activities, other quad rugby related activities, and daily life activities as seen in Table 1. Definitions for all activities were available to participants as they completed their ratings (see Appendix B).

**Procedure**

The investigator had previously met the members of the *Demolition* team after contacting the coach and visiting the practice facility at the Lakeshore Foundation. During this visit, the investigator introduced herself, spoke individually with several team members, presented a broad overview of the proposed research study, and discussed logistical issues with the coach. For recruiting purposes, the coach provided the investigator with contact information for those team members who expressed interest in participating in the study. During initial contact with potential participants, whether in- person or via phone or electronic mail, the investigator scheduled a time to meet in-person to administer the informed consent and survey. During initial contact, potential participants were given a brief description of the study using the information

**Table 1**

*Taxonomy of Various Activities Related to Individual Practice, Team Practice, Quad Rugby Related, and Daily Life*

| ***Individual Practice Activities*** | ***Quad Rugby Related Activities*** |
|---|---|
| Cardiovascular | Conversing about Quad Rugby |
| Flexibility | Coaching Quad Rugby |
| Game Video Analysis | Diet Planning |
| Mental Training | Physiotherapy |
| Technique | Reading about Quad Rugby |
| Weight Training | Training Journal |
| Working with a Coach | Watching Quad Rugby |
| ***Team Practice Activities*** | ***Daily Life Activities*** |
| Cardiovascular | Active Leisure |
| Flexibility | Nonactive Leisure |
| Game Video Analysis | Snacking |
| Mental Training | Sleeping |
| Technique | Work/Study |
| Weight Training | House Duties |
| Working with a Coach | Transportation |
| | Body Care |

on the informed consent form (see Appendix C) and were asked to bring training logs to the meeting if they had them.

During the survey administration meeting, all participants provided voluntary informed consent prior to beginning the survey. Part I and Part II of the survey were administered during the same session in a setting that was mutually agreed upon by both the participant and the investigator. For each part of the survey, verbal and written instructions were provided (verbal instructions are outlined in Appendix E). The investigator was available throughout the entire administration period and participants had the opportunity to ask questions at any time. Each administered survey took from 45-150 minutes to complete, depending upon the length of the participant's career and the nature of any accommodations needed.

**Data Treatment and Analysis**

*Part I*

Consistent with previous deliberate practice research, biographical information was summarized and accumulated amount of practice was calculated as a function of the number of consecutive years involved in quad rugby (Ericsson et al., 1993; Helsen et al., 1998; Hodges & Starkes, 1996). For each athlete, accumulated practice hours were calculated for each two-year interval by multiplying their total hours per week by the total number of weeks in each two-year period adjusted for off-season time (104 weeks minus total number of weeks off in two-year period). Results for each athlete were used to plot data of accumulated hours of practice by years of participation in two-year intervals, which were then visually inspected to identify the nature of the relationship between these two factors. In addition, disability information and involvement in other activities were summarized and examined to determine if these factors potentially influenced the plotted relationship between accumulated hours and years of participation.

*Part II*

Consistent with previous research (Ericsson et al., 1993; Helsen et al., 1998; Hodges & Starkes, 1996; Young & Salmela, 2002), ratings for activities were compared to a grand mean for each of the four dimensions rated (relevance, effort, enjoyment, and concentration). Because not all participants rated every activity, overall means were calculated using only the ratings that each participant provided. Comparisons between the ratings for each activity and the dimension grand means were completed using dependent paired t-tests. To protect for Type I error inflation a Bonferroni correction was implemented by dividing the original alpha value or .05 by the number of activities rated. This resulted in a corrected alpha level set at $\leq .002$.

# Chapter 4

## Results

### Part I

*Biographical Information*

The age of quad rugby participants ranged from age 19 to age 40 ($M$ = 31.3 yr; $SD$ = 7.3 yr). Reported quad rugby classifications, based upon the classification scale established by the United States Quad Rugby Association, were class 1.0 ($n$ = 1); class 2.0 ($n$ = 3); class 2.5 ($n$ = 2); class 3 ($n$ = 2); and class 3.5 ($n$ = 2). Three participants acquired their disability at birth. One participant acquired their disability between age 5 and 10. Three participants acquired their disability between ages 15 and 20 and three participants between age 20 and 25.

The age when participants began quad rugby ranged from 15 to 31 ($M$ = 22.9 yr; $SD$ = 4.1 yr). The mean age that participants began working with a coach was 23.8 yr ($SD$ = 4.2 yr) and the mean age that participants became engaged in year round participation was 23.0 yr ($SD$ = 4.1 yr). The mean number of years that participants had engaged in quad rugby ranged from 1 to 18 yr ($M$ = 8.5 yr; $SD$ = 6.6 yr).

Each participant's highest level of competition ranged from national level to the international (Paralympic) level. All participants were currently training for the national level tournament through the United States Quad Rugby Association. National level was the highest level of competition for six participants, one participant had competed at the international club level, and three participants had competed in the Paralympics.

Half of the participants had been involved competitively in another disability-sport prior to or during training for quad rugby. Two of these five participants had been competitively involved in two disability-sports other than quad rugby. The competitive levels attained in

secondary disability-sports included: Paralympic swimming and Paralympic track and field event ($n$ = 2), World Championships in wheelchair racing ($n$ = 1), U.S. Nationals in track and field event ($n$ = 1), and Division II college wheelchair basketball ($n$ = 1). One participant was involved in able-bodied sport at the Division II college level before participating in quad rugby (i.e., football). The remaining four participants had been involved only in the sport of quad rugby.

*Retrospective Estimates of Time Spent in Practice and Daily Life Activities*

Tables 2 and 3 show the descriptive statistics for weekly hours of participation in each of the practice and daily life activities included in the survey.

*Individual Practice*

All participants engaged in cardiovascular training and weight training, and the majority participated in flexibility training ($n$ = 8). Five or fewer participants engaged in work with a coach ($n$ = 4), mental preparation ($n$ = 3), technique work ($n$ = 5), and game video analysis ($n$ = 3). The greatest amount of time was spent in cardiovascular training ($M$ = 4.28 hr/wk; $SD$ = 2.99 hr/wk) and the least amount of time was spent in game video analysis ($M$ = .67 hr/wk; $SD$ = .29 hr/wk). Figure 1 shows the percentage of weekly time devoted to individual practice activities. Individual practice comprised 6% of the total time participants devoted to the activity categories represented in the survey. Figure 2 shows the mean hours per week spent in individual practice as a function of the number of years into the participants' quad rugby careers. An average of about five hours per week was devoted to individual practice activities at the start of the career. This amount increased steadily to a peak of about 12 hours per week at 11-12 years into the career. After that, the average amount of time decreased dramatically. Because of different career lengths, the number of participants reporting decreased as career length increased.

**Table 2**

*Mean Hours per Week for Activities Related to Individual and Team Practice*

| Activity | *N* | *Min* | *Max* | *M* | *SD* |
|---|---|---|---|---|---|
| Individual Practice | | | | | |
| Cardiovascular Training | 10 | 1.00 | 9.88 | 4.28 | 2.99 |
| Weights | 10 | 0.93 | 5.75 | 2.55 | 1.66 |
| Work with Coach | 4 | 0.73 | 5.82 | 2.35 | 2.34 |
| Mental Preparation | 3 | 0.83 | 1.50 | 1.24 | 0.36 |
| Technique | 5 | 0.30 | 1.63 | 1.16 | 0.51 |
| Flexibility | 8 | 0.22 | 1.63 | 0.84 | 0.53 |
| Game Video Analysis | 3 | 0.50 | 1.00 | 0.67 | 0.29 |
| Team Practice | | | | | |
| Work with Coach | 10 | 3.08 | 11.55 | 6.37 | 2.82 |
| Cardiovascular Training | 10 | 2.00 | 10.67 | 4.57 | 3.45 |
| Weights | 3 | 1.50 | 2.00 | 1.83 | 0.29 |
| Technique | 10 | 0.25 | 2.92 | 1.32 | 0.77 |
| Mental Preparation | 7 | 0.50 | 2.00 | 1.21 | 0.61 |
| Game Video Analysis | 3 | 1.00 | 1.40 | 1.13 | 0.23 |
| Flexibility | 10 | 0.17 | 1.47 | 0.59 | 0.42 |

***Note***. Data are listed in descending order of mean number of hours per week in each activity category.

**Table 3**

*Mean Hours per Week for Activities Related to Quad Rugby and Daily Life*

| Activity | *N* | Minimum | Maximum | *M* | *SD* |
|---|---|---|---|---|---|
| Quad Rugby Related | | | | | |
| Reading About QR | 4 | 1.00 | 1.83 | 1.35 | 0.42 |
| Physiotherapy | 8 | 0.25 | 1.50 | 0.94 | 0.40 |
| Conversing About QR | 9 | 0.03 | 2.00 | 0.93 | 0.58 |
| Organization/Preparation | 8 | 0.08 | 2.25 | 0.93 | 0.70 |
| Training Journal | 3 | 0.67 | 1.17 | 0.92 | 0.25 |
| Watching QR | 5 | 0.50 | 1.00 | 0.85 | 0.22 |
| Coaching QR | 1 | 0.80 | 0.80 | 0.80 | 0.00 |
| Diet Planning | 7 | 0.07 | 2.42 | 0.73 | 0.83 |
| Daily Life | | | | | |
| Sleep/Study | 10 | 44.10 | 78.55 | 58.64 | 11.21 |
| Transportation | 10 | 3.33 | 160.00 | 22.71 | 48.37 |
| Nonactive Leisure | 10 | 1.00 | 37.33 | 14.99 | 11.43 |
| Snacking | 10 | 1.07 | 63.00 | 12.46 | 18.05 |
| Household Duties | 9 | 0.33 | 21.00 | 5.87 | 6.16 |
| Body Care | 10 | 1.30 | 11.67 | 5.86 | 3.33 |
| Active Leisure | 6 | 0.25 | 7.00 | 2.36 | 2.49 |

*Note.* Data are listed in descending order of mean number of hours per week in each activity category; QR = quad rugby.

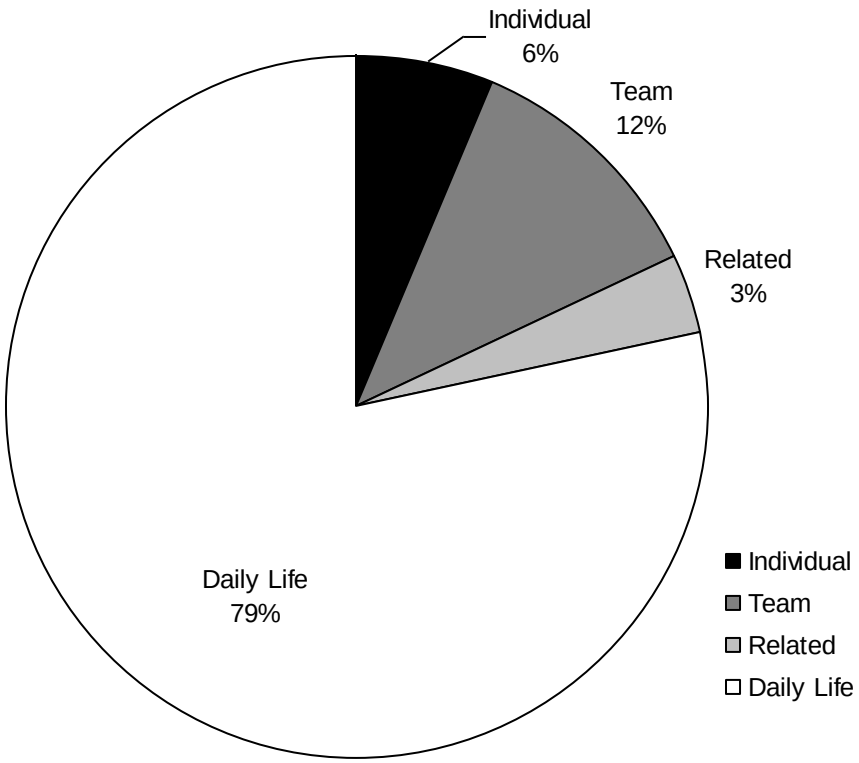


**Figure 1**

Percentage of weekly time devoted to each of the four activity categories (individual, team, quad rugby related, and daily life) during quad rugby training.

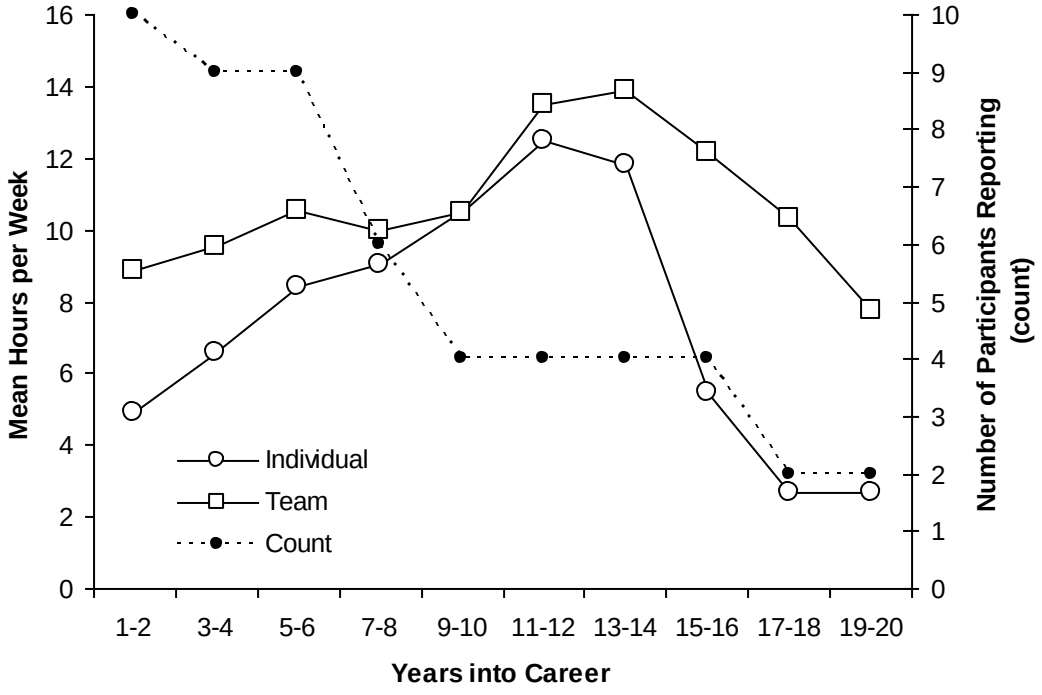


**Figure 2**

Mean hours per week spent in individual and team practice activities as a function of the number of years into quad rugby career. Secondary y-axis reflects the number of participants that responded at each career interval. *Note*: The team practice values for two participants in the 9-10 and 11-12 periods as well as the value for one participant in the 13-14 period were excluded because they included hours spent in training camps which did not reflect a "typical week".

*Team Practice*

All participants engaged in work with a coach, cardiovascular training, technique work, and flexibility training, and a majority engaged in mental training ($n$ = 7). Only three participants engaged in weight training and game video analysis. The greatest amount of time was spent in work with a coach ($M$ = 6.37 hr/wk; $SD$ = 2.82 hr/wk) and the least amount of time was spent in flexibility training ($M$ = .59 hr/wk; $SD$ = .42 hr/wk). Figure 1 shows the percentage of weekly time devoted to team practice activities. Team practice comprised 12% of the total time participants devoted to the activity categories represented in the survey. Figure 2 shows the mean hours per week spent in team practice as a function of the number of years into the participants' quad rugby careers. An average of about nine hours per week was devoted to team practice activities at the start of the career. This amount increased steadily to a peak of about 14 hours per week at 13-14 years into the career. After that, the average amount of time decreased dramatically. Because of different career lengths, the number of participants reporting decreased as career length increased.

*Quad Rugby Related*

No participants engaged in all of the quad rugby related activities. A majority engaged in physiotherapy ($n$ = 8), conversing about quad rugby ($n$ = 9), organization/preparation ($n$ = 8), and diet planning ($n$ = 7). Five or fewer participants engaged in watching quad rugby ($n$ = 5), reading about quad rugby ($n$ = 4), and training journals ($n$ = 3). Only one participant had engaged in coaching quad rugby. The greatest amount of time was spent in reading about quad rugby ($M$ = 1.35 hr/wk; $SD$ = .42 hr/wk) and the least amount of time was spent in diet planning ($M$ = .73 hr/wk; $SD$ = .83 hr/wk). Figure 1 shows the percentage of weekly time devoted to quad

rugby related activities. Quad rugby related activities comprised 3% of the total time participants devoted to the activity categories represented in the survey.

*Daily Life*

All participants engaged in sleep/study, transportation, nonactive leisure, snacking, and body care. A majority engaged in household duties ($n$ = 9) and active leisure ($n$ = 6). The greatest amount of time was spent in sleep and study ($M$ = 58.64 hr/wk; $SD$ = 11.21 hr/wk) and the least amount of time was spent in active leisure ($M$ = 2.36 hr/wk; $SD$ = 2.49 hr/wk). Figure 1 shows the percentage of weekly time devoted to daily life activities. Daily life activities comprised 79% of the total time participants devoted to the activity categories represented in the survey.

*Accumulated Practice*

Figure 3 shows mean accumulated hours of practice in two-year periods for each participant's quad rugby careers. At the start of their careers (i.e., the first two year period), participants had accumulated from 513 to 1741 hr ($M$ = 908 hr; $SD$ = 412 hr) which was the equivalent of 257 to 871 hr/yr. The four participants that reported for the 9-10 year period had accumulated from 2744 to 13768 hr ($M$ = 8309 hr; $SD$ = 4756 hr) which equated to a yearly average across the 10 years that ranged from 137 to 688 hr/yr

*Secondary Disability-Sports*

Participation in secondary disability-sports during their quad rugby career was reported by five participants ($n$ = 5). Time in secondary disability-sport practice at beginning of quad rugby career ($M$ = 938 hr/yr) generally decreased throughout the career ($M$ = 600 hr/yr at 12 yr into career), while time in quad rugby practice generally increased.

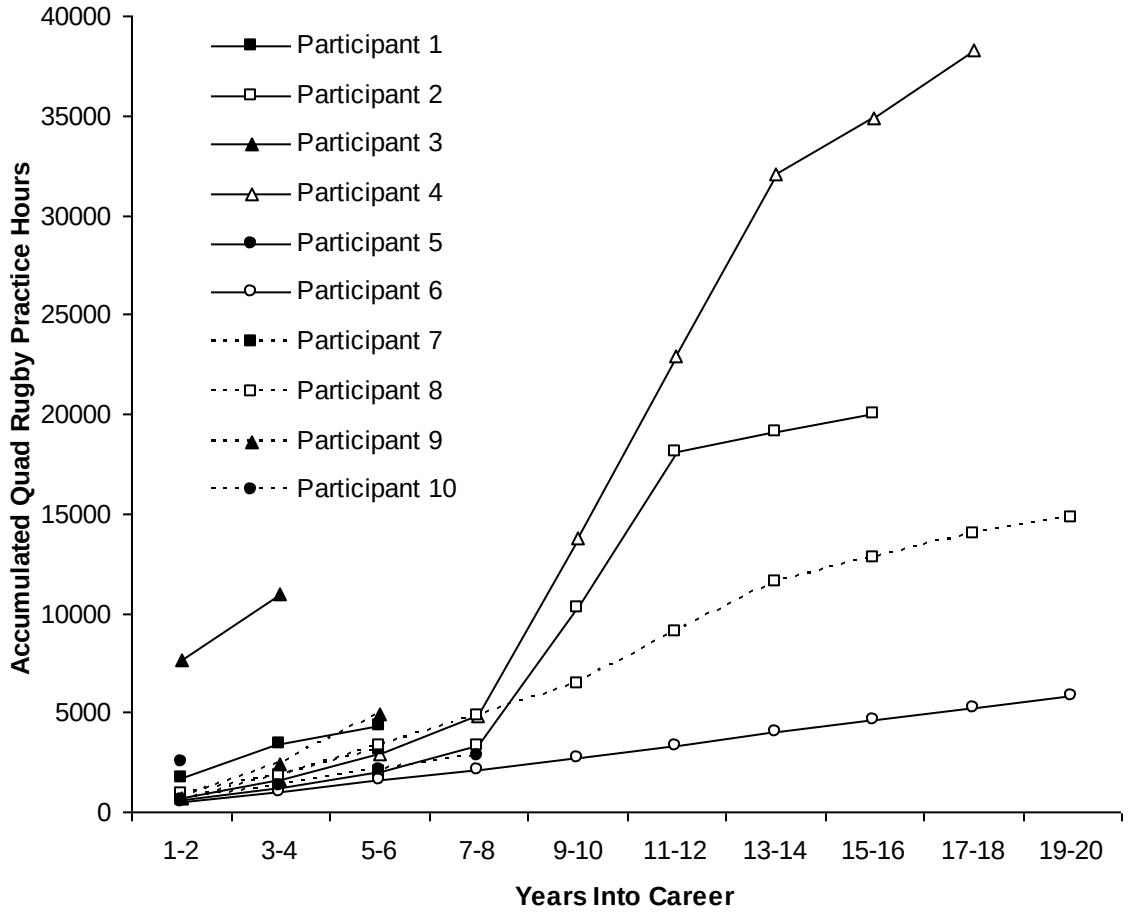


**Figure 3**

Accumulated hours of practice as a function of the number of years into quad rugby career.

**Part II**

*Ratings of Activities*

*Individual Practice*

Table 4 displays the means and grand means for individual practice activities related to the dimensions of relevance, effort, enjoyment, and concentration. Additional detailed statistical results are reported in Appendix F. Relevance ratings for cardiovascular training, technique work, and work with a coach were significantly higher than the corresponding grand means for relevance ($p \leq .002$). Effort ratings for cardiovascular training and technique work were also significantly higher than the corresponding grand means for effort ($p \leq .002$). Enjoyment ratings for all individual practice activities were not significantly different from the corresponding grand means for enjoyment. Concentration ratings for flexibility were significantly lower than the corresponding grand means for concentration ($p \leq .002$). For mental preparation, technique work, and work with coach, concentration ratings were significantly higher than the corresponding grand mean for concentration ($p \leq .002$).

*Team Practice*

Table 5 displays the means and grand means for team practice activities related to the dimensions of relevance, effort, enjoyment, and concentration. Additional detailed statistical results are reported in Appendix F. Relevance ratings for cardiovascular training, technique work, and work with a coach were significantly higher than the corresponding grand means for relevance ($p \leq .002$). Effort ratings for cardiovascular training and technique work were also significantly higher than the corresponding grand means for effort ($p \leq .002$). Enjoyment ratings for all individual practice activities were not significantly different from the corresponding grand

**Table 4**

*Ratings for Individual Practice Activities*

| Individual Practice | *N* | Relevance | Effort | Enjoyment | Concentration |
|---|---|---|---|---|---|
| | | Mean (Grand Mean) | Mean (Grand Mean) | Mean (Grand Mean) | Mean (Grand Mean) |
| Cardiovascular | 10 | **10.00*** (7.65) | **9.40*** (6.00) | **5.00** (6.23) | **7.10** (5.86) |
| Flexibility | 10 | **7.40** (7.65) | **4.10** (6.00) | **4.60** (6.23) | **3.00*** (5.86) |
| Game Analysis | 6 | **6.33** (7.62) | **4.86** (6.63) | **4.43** (6.56) | **7.00** (6.41) |
| Mental Preparation | 7 | **8.57** (7.69) | **5.29** (6.63) | **7.29** (6.56) | **9.57*** (6.41) |
| Technique | 10 | **9.50*** (7.65) | **8.60*** (6.00) | **7.30** (6.23) | **8.70*** (5.86) |
| Weights | 10 | **8.50** (7.65) | **8.60** (6.00) | **6.10** (6.23) | **6.60** (5.86) |
| Work with Coach | 8 | **9.36*** (7.66) | **6.38** (6.09) | **6.75** (6.13) | **8.88*** (5.95) |

*Note.* 0 = low; 10 = high.

*N* = number of responding participants for each pair wise comparison.

* $p \leq .002$.

**Table 5**

*Ratings for Team Practice Activities*

| Team Practice | *N* | Relevance | Effort | Enjoyment | Concentration |
|---|---|---|---|---|---|
| | | Mean (Grand Mean) | Mean (Grand Mean) | Mean (Grand Mean) | Mean (Grand Mean) |
| Cardiovascular | 10 | **10.00*** (7.65) | **9.00*** (6.00) | **6.20** (6.23) | **7.20** (5.86) |
| Flexibility | 9 | **7.33** (7.60) | **4.67** (5.85) | **4.67** (6.20) | **3.22*** (5.85) |
| Game Analysis | 4 | **7.50** (7.75) | **5.75** (7.15) | **6.50** (7.17) | **7.25** (7.08) |
| Mental Preparation | 6 | **7.17** (7.48) | **4.67** (6.56) | **5.17** (6.79) | **7.50** (6.53) |
| Technique | 10 | **9.10*** (7.65) | **7.90*** (6.00) | **6.40** (6.23) | **8.00** (5.86) |
| Weights | 4 | **8.00** (7.67) | **8.75** (6.38) | **6.25** (6.92) | **7.25** (6.47) |
| Work with Coach | 10 | **9.80*** (7.65) | **6.40** (6.00) | **7.70** (6.23) | **8.90*** (5.86) |

*Note.* 0 = low; 10 = high.

*N* = number of responding participants for each pair wise comparison.

* $p \leq .002$

means for enjoyment. Concentration ratings for flexibility were significantly lower than the corresponding grand means for concentration ($p \leq .002$). For work with a coach, concentration ratings were significantly higher than the corresponding grand mean for concentration ($p \leq .002$). Concentration ratings for technique were marginally significantly ($p < .003$) higher than the corresponding grand means for concentration.

*Quad Rugby Related*

Table 6 displays the means and grand means for other quad rugby activities related to the dimensions of relevance, effort, enjoyment, and concentration. Additional detailed statistical results are reported in Appendix F. Relevance ratings for all quad rugby related activities were not significantly different from the corresponding grand means for relevance. Effort ratings for all quad rugby related activities were not significantly different from the corresponding grand means for effort. Enjoyment ratings for all quad rugby related activities were not significantly different from the corresponding grand means for enjoyment. Concentration ratings for all quad rugby related activities were not significantly different from the corresponding grand means for concentration.

*Daily Life*

Table 7 displays the means and grand means for quad rugby activities related to the dimensions of relevance, effort, enjoyment, and concentration. Additional detailed statistical results are reported in Appendix F. Relevance ratings for household duties were significantly lower than the corresponding grand means for relevance ($p \leq .002$). Effort ratings for all daily life activities were not significantly different from the corresponding grand means for effort. Enjoyment ratings for nonactive leisure and sleeping were significantly higher than the

**Table 6**

*Ratings for Quad Rugby Related Activities*

| Quad Rugby Related | *N* | Relevance | Effort | Enjoyment | Concentration |
|---|---|---|---|---|---|
| | | Mean (Grand Mean) | Mean (Grand Mean) | Mean (Grand Mean) | Mean (Grand Mean) |
| Conversing about QR | 10 | **7.30** (7.65) | **5.80** (6.00) | **6.70** (6.23) | **5.70** (5.86) |
| Coaching QR | 3 | **9.33** (7.67) | **8.33** (6.78) | **9.00** (6.97) | **9.33** (6.95) |
| Diet Planning | 8 | **8.13** (7.52) | **8.25** (6.38) | **5.00** (6.44) | **7.63** (6.22) |
| Physiotherapy | 4 | **6.75** (7.53) | **6.00** (6.27) | **8.50** (6.44) | **3.25** (6.33) |
| Reading QR Material | 4 | **5.75** (7.76) | **5.25** (7.02) | **6.50** (7.04) | **5.00** (6.65) |
| Training Journal | 3 | **8.33** (7.81) | **7.00** (7.06) | **7.67** (7.27) | **6.67** (6.90) |
| Organization/Preparation | 7 | **8.71** (7.70) | **7.29** (6.07) | **5.43** (6.40) | **6.14** (5.83) |
| Watching QR | **5** | **9.20** (7.94) | **7.40** (6.71) | **6.80** (6.65) | **7.00** (6.38) |

*Note.* 0 = low; 10 = high.

*N* = number of responding participants for each pair wise comparison; QR = quad rugby.

* $p \leq .002$

**Table 7**

*Ratings for Daily Life Activities*

| Daily Life | *N* | Relevance | Effort | Enjoyment | Concentration |
|---|---|---|---|---|---|
| | | Mean (Grand Mean) | Mean (Grand Mean) | Mean (Grand Mean) | Mean (Grand Mean) |
| Active Leisure | 9 | **6.33** (7.65) | **5.22** (5.84) | **8.22** (6.16) | **4.44** (5.66) |
| Nonactive Leisure | 10 | **3.80** (7.65) | **2.60** (6.00) | **9.30*** (6.23) | **1.90*** (5.86) |
| Snacking | 10 | **7.60** (7.65) | **4.70** (6.00) | **8.20** (6.23) | **3.40** (5.86) |
| Sleeping | 10 | **8.80** (7.65) | **3.70** (6.00) | **9.40*** (6.23) | **4.10** (5.86) |
| Work | 9 | **6.78** (7.79) | **6.56** (6.15) | **4.89** (6.31) | **6.67** (5.97) |
| Household Duties | 9 | **1.67*** (7.64) | **4.56** (6.28) | **3.89** (6.29) | **3.78** (6.12) |
| Transportation | 10 | **5.20** (7.65) | **4.50** (6.00) | **4.40** (6.23) | **5.10** (5.86) |
| Body Care | 10 | **7.70** (7.65) | **5.90** (6.00) | **5.10** (6.23) | **5.10** (5.86) |

*Note.* 0 = low; 10 = high.

*N* = number of responding participants for each pair wise comparison; QR = quad rugby.

* $p \leq .002$

corresponding grand means for enjoyment ($p \leq .002$). Concentration ratings for nonactive leisure were significantly lower than the corresponding grand means for concentration ($p \leq .002$).

# Chapter 5

## Discussion

### Part I

The first purpose of this study was to examine how well the deliberate practice framework accurately describes the accumulated hours of domain-specific practice for expert disability-sport athletes. Quad rugby participants in this study reported a mean of 8309 hr (*SD* = 4756 hr) of accumulated team and individual practice at 9 to 10 yr into their careers. This was consistent with previous findings on accumulated hours necessary for the attainment of superior performance. Quad rugby participants engaged in similar hours at 9 to 10 yr into their careers as those reported by Ericsson et al.'s (1993) best violinists at 10 years (*M* = 6351 hr), Hodges and Starkes' (1996) wrestlers (*M* = 5865 hr) at 10 years, and Helsen et al.'s (1998) soccer (*M* = 6328 hr) and field hockey athletes (6559 hr) at 13 years into their careers. This study found that disability-sport athletes were able to participate in similar amounts of training compared to their able-bodied counterparts. In fact, there was no evidence of additional constraints (e.g., increased daily life preparation requirements, reduced availability of practice locations, and reduced availability of equipment) that negatively affected the amount of potential hours available for training. This finding seems at odds with the common perception that a physical disability introduces, at the very least, a need for additional time to complete most daily activities, which raises the possibility that participants in this study sacrificed time in other activities that were not included in the survey. Thus, further research is recommended to clarify this issue.

In contrast to previous findings regarding expertise and deliberate practice, quad rugby participants began practicing well into early adulthood, at about 23 years of age. Thus, it was observed that quad rugby participants begin their career dramatically later than musicians and

athletes in able-bodied sports. Beginning practice ages have been noted at eight years of age for musicians, five years of age for soccer players, and 13 years of age for wrestlers (Ericsson et al., 1993; Helsen et al., 1998; Hodges & Starkes, 1996). The age of entrance results from this study are similar to previous disability-sport research by Watanabe et al. (1992) and Hedrick et al. (1988), which found the age of entrance to disability-sport to be an adult phenomenon (age of 24 to 26 yr). Therefore this study concurred with an adult phenomenon of entrance age for disability-sport participants. Additionally, participants reported beginning quad rugby, working with a coach, and engaging in year round participation near the same adult age. This finding shows that high-level performance can still be attained with initiation of deliberate practice late in adulthood for disability-sport athletes.

Quad rugby participants showed an increase in mean practice hours per week from start of career until the time period of 11 to 14 years into career for both individual and team practice. This was followed by a decrease in the mean number of practice hours per week after 14 years in career for individual and team practice. Previous research on soccer and field hockey revealed a steep increase in mean hours per week from 9 to 15 years followed by an asymptote (Helsen et al., 1998). Helsen et al. (1998) found an increase of time in team practice across career and a decrease of time in individual practice which was not observed in the present study. Across their quad rugby careers, half of the participants ($n$ = 5) were engaged in additional hours of practice for secondary disability-sports above and beyond their quad rugby commitments. Because time and energy available for participation are key aspects of Ericsson et al.'s (1993) constraints, competitive participation in secondary disability-sports may explain why some participants did not report increases in team practice consistent with expectations of the deliberate practice framework.

Team practice was the primary component of deliberate practice activities, accounting for 12% of the time devoted to all surveyed activities each week. Individual practice comprised the smaller proportion, accounting for 6% of the time devoted to surveyed activities. Because quad rugby is a team sport, it may be that specific activities necessary to the sport are most effectively improved in a team training environment. The importance of such practice with others has been discussed in previous research. For example, even in an individual sport such as wrestling, the importance of sparring practice with partners was rated significantly higher than the mean (Hodges & Starkes, 1996). Similarly, research on soccer and field hockey has found that 65% and 53% of practice time was spent in team practice, respectively (Helsen et al., 1998). In the present study, the largest amount of time in team practice occurred in cardiovascular training and working with a coach. Technique work and flexibility were engaged in by all participants, but for a smaller quantity of time during team practice. Game video analysis and working with weights as a team were engaged in by the smallest number of participants.

The analyses of individual practice activities revealed that the greatest amount of time was spent in cardiovascular training and weights, with all participants engaging in both activities. Half of the participants engaged in technique work individually, revealing that this type of training was accomplished during both team and individual practice. Relatively few participants engaged in individual practice involving game video analysis and mental preparation. Game video analysis and technique work contributed the least amount of time for both team and individual practice. It is unknown if the relatively low levels of participation in activities such as game video analysis (individually and with the team) and mental preparation were due to limited availability of resources, time, interest, or other possible factors.

**Part II**

The second purpose of this study was to address whether disability-sport athletes would rate deliberate practice activities high on relevance and effort, but low on inherent enjoyment as predicted by Ericsson et al. (1993), or if they would rate these activities as high on all three dimensions as indicated by subsequent research in the sport domain (e.g., Helsen et al., 1998). Similar to previous research, the requirement of high relevance and high concentration was found to exist for three activities in quad rugby athletes. Individual technique work, working with coach individually, and working with coach in team practice, were all rated high on relevance and concentration. Team technique work was also found to have a high rating for relevance and a (marginally significant) high rating for concentration. This finding was similar to research conducted on musicians (Ericsson et al., 1993), wrestlers (Hodges & Starkes, 1996), and martial arts (Hodge & Deakin, 1998), which found a corresponding relationship between high concentration and high relevance.

Previous research has found that activities mirroring the demands of the actual performed activity are rated high in relevance. For quad rugby, ratings of high relevance and high effort were seen in four activities including individual cardiovascular, team cardiovascular, individual technique work, and team technique work. Previous studies have reported ratings of high relevance for practicing alone by musicians (Ericsson et al., 1993), technical and tactical practice by soccer and field hockey players (Helsen et al., 1998), and running by middle distance (Young & Salmela, 2002). In the present study, cardiovascular training and technique work were therefore identified as important components of practice that closely simulate the actual performance demands of competitive quad rugby.

Consistent with previous research, working with a coach was rated high in relevance for both individual and team practice (Starkes et al., 1996; Hodges & Starkes, 1996; Ericsson et al., 1993). Previous disability-sport research has not addressed the relevance of a coach from the participant's perspective. In the present study, working with a coach in a team setting also revealed high ratings for concentration as did both team (presumably under the supervision of a coach) and individual technique work. It is possible that the high degree of concentration for team technique work was partly due to participants' efforts to interpret the coach's instructions and feedback. For individual technique work, high concentration may be directed toward self-monitoring efforts. These findings extended current understanding of participant's perception of the coach and supported the notion that interaction with a coach is a relevant and effortful aspect of quad rugby training. The results of this study also supported the distinction between (mental) concentration and (physical) effort seen in previous research in the sport domain (e.g., Hodges & Starkes, 1996). Cardiovascular and technique work were rated as high in (physical) effort for individual and team practice while mental preparation was rated high in (mental) concentration.

Another finding that was consistent with previous research in the sport domain was the high ratings for enjoyment were found for the daily life activities of nonactive leisure and sleeping (e.g., Helsen et al., 1998; Hodge & Deakin, 1998). In contrast to expectations emerging from the original framework forwarded by Ericsson et al. (1993), the present study did not find any activities that were rated high for relevance and effort but low for enjoyment. In addition, no activities were rated high for relevance and enjoyment as reported in previous research in the able-bodied sport domain. Instead, the present study found none of the activities were rated significantly higher or lower than the grand mean for enjoyment. These neutral ratings for enjoyment raise the question of what motivates disability-sport athletes to engage in deliberate

practice activities. The International Paralympic Committee (2009) states that disability-sport may provide an outlet for social engagement, competition opportunities, and physical rehabilitation. Perhaps one or more of these potential benefits may be what motivates disability-sport athletes.

Overall, the findings from this study revealed limitations in both Ericsson et al.'s (1993) deliberate practice framework and the sport modified framework when describing the characteristics and developmental experiences of disability-sport athletes. Nevertheless, many of the characteristics described by Ericsson et al.'s (1993) framework were observed in this study, suggesting that it may prove adequate with some revision to account for the present findings that were unique to disability-sport (e.g., neutral ratings of enjoyment). Future research that examines the specific constraints and motivations for disability-sport athletes and further documents the characteristics associated with their expertise will contribute not only to the theoretical development of the deliberate practice framework, but will also increase critical knowledge that may benefit an underserved population.

**Recommendations for Future Studies**

Based on the present study, the following recommendations for future research are offered.

1. Future studies should include a section that allows for participants to discuss specific training that may not be included in typical hours in a normal week (e.g., weekend training camps for the Paralympics). These intense training periods, with very high level of competition and practice, may provide a more complete picture of disability-sport training. When only the "typical" or "normal" hours per week are recorded, the larger picture of the disability-sport training environment may not be completely captured.

2. Since participants in this study did not use training logs, it may be suggest that retrospective recall of athletes be paired with an alternative method to verify the extent to which these activities are actually pursued in practice. Other research has suggested methods such as time-motion study of the microstructure of practice (Helsen et al., 1998).
3. Future studies to further explore other disability-sports (i.e., wheelchair basketball, swimming) at the international and national level of competition may be beneficial in providing a more defined experience and characteristic of disability-sport athletes.

**Conclusions**

Based on the findings of the present study the following conclusions seem appropriate:

1. Quad rugby participants have similar characteristics to those who have attained superior performance in other domains regarding the number of hours spent in deliberate practice across career. Age of initiation in the acquisition period is different for quad rugby participants and is currently found to be an adult phenomenon.
2. Quad rugby participants do not entirely match the framework established by Ericsson et al. (1993) in regard to activities being rated high in relevance and effort, and low in enjoyment. Quad rugby participants do not completely fit the revised framework of deliberate practice as suggested by previous studies in the sport domain as activities that are rated high in relevance and effort are not rated high in enjoyment (e.g., Helsen et al., 1998). It is concluded that quad rugby, and potentially other disability-sports, may have a unique characteristics not yet incorporated into any deliberate practice framework.
3. Despite quad ruby players neutral ratings of enjoyment, the deliberate practice framework and sport modified concept provide an adequate and general picture of disability-sport experts. Overall across domains, deliberate practice activities must be engaged in high

quantity and are consistently viewed as relevant and effortful, but some activities are found to be enjoyable and others are not.

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**APPENDICES**

## Appendix A: Quad Rugby Description

***Description of Quad Rugby***

Murderball was the original name for wheelchair rugby, but it is now commonly referred to as quad rugby. Quad rugby was developed in Canada and came to the United States in 1981 (United States Quad Rugby Association: The game, 2009). Quad rugby players must have a combination of both upper- and lower-extremity impairments to participate. Male and female athletes compete together in quad rugby games at all levels of competition. Players go through a classification process and are classified into one of seven categories based upon the degree of their impairment. The categories begin at class .5 (greatest impairment) to class 3.5 (least impairment). Four players may be on the court at a time for each team, but the team must not exceed 8 total classification pointsl at any time. Games are played with a volleyball on a regulation-sized indoor basketball court. A designated area, called a key, at each end line measures eight meters wide and 1.75 meters deep. A goal is scored when any two wheels of the ball carriers wheelchair crosses the goal line, which is the baseline of the key area.

Quad rugby is a full contact sport, but inappropriate physical contact (e.g., biting, slapping, and hitting) is penalized by sending the offender to a penalty box. On offense, different techniques are used to pass the ball including hand-passes and punching/batting the ball (Gulick, Berge, Borger, Edwards & Rigterink, 2006). On defense, players use their wheelchairs to block opponents or collide with the offense to attempt to either free the ball through the impact of the collision or steal the ball directly from the opponent (Gulick et al., 2006). The game lasts for 32 minutes, with time divided into four 8-minute quarters.

***United States Quad Rugby Association***

The United States Quad Rugby Association (USQRA) is the governing body for quad rugby in the United States. The USQRA states that they exist "to provide opportunity, support,

and structure for competitive wheelchair rugby to people with disabilities. "We are here to help people get involved in the fastest growing wheelchair sport in the world" (United States Quad Ruby Association: Welcome, 2009, para. 1). In 1988 the first US National Championship Tournament was held with 6 teams and it was after this tournament that the United States Quad Rugby Association was formed to help regulate and promote quad rugby. There are currently 31 teams established through this association divided into eight different regions including: Atlantic North, Atlantic South, Heartland North, Heartland South, Mountain East, Mountain West, Pacific North, and Pacific South. A few of the teams in the USQRA have proven to be dominating forces. In 1995, the Tampa Generals from the Atlantic South won their third National Championship. In 1999 Sharp Shadows won their third straight National Championship. In 2004, the Lakeshore Demolition, from the Heartland South division, won their fifth straight National Championship (United States Quad Ruby Association: About us, 2009).

***Quad Rugby in the United States***

The typical United States quad rugby season begins in late October and ends with the National Championship in April each year. Every four years a United States National team is formed to compete at the Paralympic Games which follows the Olympic Games. The United States quad rugby athletes have shown themselves to be among the best quad rugby athletes worldwide. In the 2000 Sydney Paralympic Games, Team USA took the gold medal in a close win over Australia by just one point. In the 2004 Athens Paralympic Games, New Zealand took the gold medal, Canada the silver, and Team USA the bronze. In 2006, the United States reclaimed the position as the top quad rugby team in the world. Team USA was undefeated in all three international tournaments including the World Championships in New Zealand, where they

defeated New Zealand to take home the gold medal. In the 2008 Bejing Paralympic Games, Team USA earned the top ranking in the world by winning the gold medal by defeating Australia in a 53-44 win.

## Appendix B: Survey Terms and Definitions

# Individual Quad Rugby Activities

**Cardiovascular Training** – includes pushing, hand cycle, upper body ergometer (UBE), swimming, rowing, etc. used to improve performance.

**Flexibility** – traditional stretching exercises.

**Game Video Analysis** – watching video of your quad rugby performance.

**Mental Preparation** – includes visualization/imagery, work on mental game plans, focus strategies distraction control, goal setting exercises, relaxation/psych-up techniques, or consultation with a sport psychologist.

**Technique** – specific work on technical movements and skills.

**Weights** – power or interval training including plyometrics, medicine ball, traditional weight lifting exercises, circuits, body weight exercises (i.e. push-ups, sit-ups, and abdominals).

**Work with a Coach** – activities in which the coach is instructing you on topics relevant to improving your quad rugby performance. The coach must be specifically directing his/her instruction towards you as an athlete or aspects of your performance. Providing encouragement, motivation, or the mere spectating presence of a coach *are not* under this label.

# Team Practice Activities

**Cardiovascular Training** – includes pushing, hand cycle, upper body ergometer (UBE), swimming, rowing, etc. used to improve performance in team practice.

**Flexibility** – traditional stretching exercises performed with the team.

**Game Video Analysis** – watching video of team quad rugby performance.

**Mental Preparation** – includes visualization/imagery, work on mental game plans, focus strategies distraction control, goal setting exercises, relaxation/psych-up techniques, or consultation with a sport psychologist as team.

**Technique** – specific work on technical movements and skills with the team.

**Weights** – power or interval training including plyometrics, medicine ball, traditional weight lifting exercises, circuits, body weight exercises (i.e. push-ups, sit-ups, and abdominals) with the team.

**Work with a Coach** – activities in which the coach is instructing the team on topics relevant to improving quad rugby performance. The coach must be specifically directing his/her instruction towards the team and the team performance. Providing encouragement, motivation, or the mere spectating presence of a coach *are not* under this label.

# Quad Rugby Related Activities

**Conversing about Quad Rugby** – conversations outside of the training environment specifically about quad rugby with other athletes, agents, and administrators.

**Coaching Quad Rugby to Others** – quad rugby instruction.

**Diet/Nutritional Planning –** monitoring your diet.

**Physiotherapy** – includes curative and preventative treatment for quad rugby related injuries. This label includes massage treatment.

**Reading Quad Rugby Material** – books, magazines, articles, tournament programs, etc.

**Training Journal** – upkeep and evaluation.

**Organization and Preparation** – includes training for quad rugby, maintenance of equipment, and traveling to quad rugby related activities

**Watching Quad Rugby** – live, on television, or on film.

# Daily Life Activities

**Active Leisure** – other recreation and sports that are not intended to improve quad rugby performance. This includes any physically demanding activities outside of quad rugby training.

**Nonactive Leisure** – includes movies, computer leisure (i.e. internet/email), correspondence with friends (i.e. talks) reading, hobbies, parties, TV, radio, bars, and physically nonactive functions that are not related to quad rugby.

**Eating/Snacking**

**Sleeping** – includes night sleep and short naps.

**Studying/Working** – seminars, courses, homework assignments, part-time, full-time employment, volunteer work, committee work

**Household Duties** – household chores (i.e. yardwork, preparing meals, cleaning, repairs, and dishwashing).

**Transportation and Commuting** – includes traveling to non-related quad rugby related activities.

**Body Care and Health** – washing, dressing, hygiene, visits to the doctor, therapy, and physiotherapy for reasons other than quad rugby related problems.

**Appendix C: IRB Form A and Informed Consent**

# FORM A

**Certification for Exemption from IRB Review for Research Involving Human Subjects**

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**A. PRINCIPAL INVESTIGATOR(s) and/or CO-PI(s)** (For student projects, list both the student and the advisor.)**:**

**Rachel L. Boxell and Dr. Jeffrey T. Fairbrother**

**B. DEPARTMENT: Department of Exercise, Sport, and Leisure Studies**

**C. COMPLETE MAILING ADDRESS AND PHONE NUMBER OF PI(s) and CO-PI(s):**

**Principle Investigator (PI) :**

**Rachel L. Boxell**
**Department of Exercise, Sport, and Leisure Studies**
**College of Education, Health, and Human Sciences**
**1914 Andy Holt Avenue, 322 HPER**
**Knoxville, TN 37996-2700**
**(239) 398-4113**
**rboxell@utk.edu**

**Faculty Advisor :**

**Jeffrey T. Fairbrother, Ph.D.**
**Department of Exercise, Sport, and Leisure Studies**
**College of Education, Health, and Human Sciences**
**1914 Andy Holt Avenue, 322 HPER**
**Knoxville, TN 37996-2700**
**(865) 974-3616**
**jfairbr1@utk.edu**

**D. TITLE OF PROJECT: An examination of the deliberate practice framework in quad rugby**

**E. EXTERNAL FUNDING AGENCY AND ID NUMBER** (if applicable)**: Not Applicable**

**F. GRANT SUBMISSION DEADLINE** (if applicable)**: Not Applicable**

**G. STARTING DATE** (NO RESEARCH MAY BE INITIATED UNTIL CERTIFICATION IS GRANTED.)**:**

**Upon IRB Approval**

**H. ESTIMATED COMPLETION DATE** (Include all aspects of research and final write-up.)**: May 2010**

**I. RESEARCH PROJECT**

**1. Objective(s) of Project** (Use additional page, if needed.)**:**

The objective of this study is to examine the deliberate practice framework with quad rugby players, focusing specifically on accumulated hours of practice and ratings of relevance, concentration, effort, and enjoyment for selected practice and life activities.

2. **Subjects** (Use additional page, if needed.)**:**

a. Participants will be apparently healthy men and women at least 18 years of age. All participants will have the ability to give voluntary and informed consent.
b. Participants will be recruited from a pool of 12 quad rugby players currently on the Lakeshore Foundation *Demolition* team located in Birmingham, AL. Recruiting will be accomplished through personal contact.
c. All potential participants meeting the criteria indicated in Part I, Items 2a and b (above) will be eligible for selection unless they cannot or will not give voluntary and informed consent.
d. It is anticipated that approximately 8-12 participants will be required over the course of this project.

3. **Methods or Procedures** (Use additional page, if needed.)**:**

This project will consist of a single study in which participants will be asked to complete a written survey. Accommodation will be available if needed for any participants who cannot complete the survey as designed (e.g., those unable to write due to their disability). This accommodation will be provided by the primary investigator. According to the coach of the Lakeshore Foundation *Demolition*, all potential participants have the capacity to answer the questions on the survey, although some may require help with writing. A copy of the survey can be found in Appendix B. It will be administered individually in a setting that is mutually agreed upon by both the participant and the investigator.

The questionnaire is divided into two parts. Part I requests biographical information concerning the age when practice was first initiated, the highest level attained in quad rugby, success in competitions, and disability information. Participants will estimate the number of hours devoted to various practice and daily life activities during a "typical week" for two-year intervals since beginning their career. Participants will be allowed to refer to personal training logs if they have them. If participants have competitive experience in other sports, they will be asked to provide information for those sports as well.

Part II of the questionnaire requires participants to rate various practice and daily life activities on four dimensions related to the deliberate practice framework: relevance to improving quad rugby performance; physical effort required; inherent enjoyment; and concentration (i.e., mental effort) required.

The survey will not request any information that can be used to directly identify a participant. The survey states specifically: "Please do not put your name or information that directly identifies you on this survey. You may end your participation in this study at any time." The investigator and her advisor will additionally take precautions to obscure any information that might indirectly lead to the identification of a participant (e.g., the reporting of the nature of a unique disability). Because the surveys will consist of multiple pages, each page of a participant's survey will be labeled with a unique code number. This code number will not be connected to the identity of the participant. Surveys will be destroyed at the end of the project.

During initial contact with potential participants, the investigator will schedule a time to meet in-person to administer the informed consent and study survey. Potential participants will be given a brief description of the study using the information on the informed consent form (Appendix A) and will be asked to bring training logs to the meeting if they have them.

All participants will provide voluntary informed consent prior to completing the survey. Part I and Part II of the questionnaire will be administered during the same session. For each part of the survey, written instructions will be provided, which the investigator will read aloud. Participants will have the opportunity to ask questions at any time during the procedure. It is estimated that each survey will take from two to four hours to complete, depending upon the length of the participants career and the nature of any accommodations needed.

**4. CATEGORY(s) FOR EXEMPT RESEARCH PER 45 CFR 46** (See instructions for categories.)**:**

(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, **unless**: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; **and** (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

**J. CERTIFICATION:** The research described herein is in compliance with 45 CFR 46.101(b) and presents subjects with no more than minimal risk as defined by applicable regulations.

**Principal Investigator**: Rachel L. Boxell _____ _____ _____
Name Signature Date

**Student Advisor**: Jeffrey T. Fairbrother, Ph.D. _____ _____
Name Signature Date

**Department Review Committee Chair**: Craig A. Wrisberg, Ph.D. _____ _____
Name Signature Date

**APPROVED:**
**Department Head**: Dixie L. Thompson, Ph.D. _____ _____ _____
Name Signature Date

**COPY OF THIS COMPLETED FORM MUST BE SENT TO COMPLIANCE OFFICE IMMEDIATELY UPON COMPLETION.**

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Rev. 01/2005

# INSTRUCTIONS FOR COMPLETING FORM A
## PLEASE TYPE THE INFORMATION REQUESTED ON THE FRONT OF THIS FORM

Provide the required information in the space available if at all possible. If additional space is necessary, attach a separate sheet. Submit one copy of this form to the Chair of your Departmental Review Committee for review and approval. [PLEASE NOTE: This form may be reproduced on a personal computer and printed on a high quality printer (*e.g.*, LaserJet, DeskJet). Form A was originally created under WordPerfect 6.1 and printed on a HP LaserJet III printer using a 9-point CG Times font.]

**ALL SIGNATURES MUST BE ORIGINAL** on this form. When certified by your department or unit head, a copy of the signed Form A will be returned to the Principal Investigator and a copy will be returned to the Research Compliance Services Section, Office of Research.

**I.1. OBJECTIVES**: Briefly state, in non-technical language, the purpose of the research, with special reference to human subjects involved.

**I.2. SUBJECTS**: Briefly describe the subjects by number to be used, criteria of selection or exclusion, the population from which they will be selected, duration of involvement, and any special characteristics necessary to the research.

**I.3. METHODS OR PROCEDURES**: Briefly enumerate, in non-technical language, the research methods which directly involve use of human subjects. List any potential risks, or lack of such, to subjects and any protection measures. Explain how anonymity of names and confidentiality of materials with names and/or data will be obtained and maintained. List the names of individuals who will have access to names and/or data.

**I.4. CATEGORY(s) FOR EXEMPT RESEARCH PER 45 CFR 46**: Referring to the extracts below from Federal regulations, cite the paragraph(s) which you deem entitle this research project to certification as exempt from review by the Institutional Review Board. **45 CFR 46.101(b): Research activities in which the only involvement of human subjects will be in one or more of the following categories are exempt from IRB review:**

(1) Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as: (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, **unless**: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; **and** (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

**PLEASE NOTE**: *An exemption cannot be used when children are involved for research involving survey or interview procedures or observations of public behavior, except for research involving observation of public behavior when the investigator(s) do not participate in the activities being observed. [45 CFR 46.401(b)]*

(3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (2) above, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) Federal statute(s) require(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

(4) Research involving the collection or study of existing data, documents, records, pathological specimens or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

(5) Research and demonstration projects which are conducted by or subject to the approval of Federal Department or Agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

(6) Taste and food quality evaluation and consumer acceptance studies, if wholesome foods without additives are consumed or if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminants at or below the level found to be safe, by the Food and Drug Administration or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the US Department of Agriculture.

For additional information on Form A, contact the Office of Research Compliance Officer by e-mail or by phone at (865) 974-3466.

Rev. 01/2005

## APPENDIX A
## INFORMED CONSENT FORM

### An examination of the deliberate practice framework in quad rugby

You are invited to participate in a research study. The first purpose of this study is to determine how much time quad rugby athletes spend in training. The second purpose is to examine how athletes rate various activities with respect to their training in quad rugby.

As a participant in this study you will complete a survey that involves answering questions about your quad rugby practice. There are no foreseeable risks associated with participation.

The investigator will assist you with each part of the survey during a one-on-one meeting. You will be given both a verbal and written explanation of how to complete each section of the survey. You may ask questions at any time during your meeting with the investigator. It is expected that the meeting to complete the survey will last approximately two hours, but you will be allowed to use more or less time if you prefer.

The first part of the survey will ask for information about your disability. You will also complete a table that requires you to recall the amount of time that you have spent training for quad rugby during specific time periods since you first began training. For this section, you may use personal training logs if you have them.

The second part of the survey will present a list of specific practice and daily life activities, and ask you to rate each one with respect to how they relate to your quad rugby training.

If you need help with writing responses, have difficulty completing any part of the survey, need further clarification of any item, or have any questions, please ask the investigator for assistance.

Your identity will not be linked to the data in any way. The information in the study records will be kept confidential. Data will be stored securely and will be made available only to Rachel L. Boxell and Dr. Jeffrey T. Fairbrother unless you specifically give permission in writing to do otherwise. No reference will be made in oral or written reports which could link you to the study.

If you have questions at anytime about the study or the procedures, you may contact the researcher, Rachel L. Boxell or her faculty advisor, Dr. Jeffrey T. Fairbrother, at 1914 Andy Holt Avenue, 322 HPER, Knoxville, TN 37996, or (865) 974-3616. If you have any questions about your rights as a participant, contact the Research Compliance Services section of the Office of Research at (865) 974-3466.

**Your participation in this study is voluntary; you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at any time without penalty and without loss of benefits to which you are otherwise entitled. If you withdraw from the study before data collection is completed, your data will be returned or destroyed.**

**I have read the above information and agree to participate in this study. I have received a copy of this form.**

**Participant's Name (Print)** _____

**Participant's Signature** _____

**Investigator's Signature**_____

**Date** _____

**Appendix D: Survey**

**Quad Rugby Survey**
**Part I**

Please do not put your name or information that directly identifies you on this survey. You may end your participation in this study at any time.

ID#: _____

Age: _____

Gender: _____

USQRA Player Classification (.5-3.5): _____

1. How old were you when you began playing quad rugby? _____
2. At what age did you begin regular practice for quad rugby with a coach? _____
3. How old were you when you became involved in quad rugby more full time or on a year round basis?

   _____
4. Are you training competitively for the 2009 quad rugby season? Yes or No
5. What is the primary quad rugby event you are training for in 2009?

   _____
6. What is your greatest personal achievement in quad rugby?

   _____

   _____
7. What is the highest level you have competed at in quad rugby?

   _____

   _____

   _____
8. At what age were you when you acquired your current disability?

   _____
9. Please describe your current disability:

_____

_____

_____

**Other competitive sports/activities:**
This may be another sport you compete/or have competed in prior to quad rugby (i.e. swimming, wheelchair racing). Please include every sport that you have participated in at a competitive level. If you have competitively played more than 2 other sports, please let the investigator know and more sheets will be provided.

1. Sport or Activity: _____

    a. How old were you when you began this sport/activity? _____

    b. Was your participation in this sport:

        _____before disability _____after disability _____both

    c. If you do not currently compete in this sport/activity, at what age did you end participation?

        _____

    d. What is the highest level you competed at?

        _____

    e. What was your greatest personal achievement in this sport/activity? _____

        _____

2. Sport or Activity: _____

    a. How old were you when you began this sport/activity? _____

    b. Was your participation in this sport:

        _____before disability _____after disability _____both

    c. If you do not currently compete in this sport/activity, at what age did you end participation?

        _____

    d. What is the highest level you competed at?

        _____

    e. What was your greatest personal achievement in this sport/activity? _____

        _____

3. What do you consider to be your primary sport? _____

**Training Log Consultation**

Please use your personal training logs to complete the following activity. By using your training logs you ensure that your information is accurate.

We are interested in finding out what a "typical week" of training was like for you at different times in your quad rugby career. When you think of a "typical week", try to consider one occurring during the competitive phase of the quad rugby season. More specifically, consider a "typical training week" that is 10 weeks prior to your major quad rugby event.

On the next page there is a chart with columns corresponding to different periods of your quad rugby career. Please write at the top of each page your age at the beginning of the indicated time period. Start Age refers to the age when you first began to regularly practice quad rugby with a coach. For example, if you started training at age 14, you will write "Age = 14" beneath "Start Age", and "Age = 16" on the "2 Years Later" page, and so on. You may find that you will not need all of the pages. If you have been training for more than 14 years, you will need an additional pages, which the investigator will provide. Please stop when you reach the page corresponding to the age you are now (or nearest to it). If you have competed in another sport, the investigator will provide additional pages for that sport.

Each row on the pages indicates a training activity. Recall the average time (in minutes) in a typical week you spent practicing that activity during the period indicated by the page you are on.

It is very important that you take your time and consider each time period and activity thoroughly. Again, if you have access to personal training logs, please consult them in order to complete this activity.

Indicate here if you are using the help of training logs in completing this chart: YES or NO

**Activity Categories**

Activities and definition are provided on separate sheets of colored paper. The investigator will go over the activities and definitions with you and the definitions will be available for you to refer to. Do not hesitate to consult the list at anytime or ask questions.

| Start Age | | | |
|---|---|---|---|
| Age = | | | |
| **Individual Practice Activities** | **Minutes per Week** | **Team Practice Activities** | **Minutes per Week** |
| Cardiovascular Training | | Cardiovascular Training | |
| Flexibility | | Flexibility | |
| Game Video Analysis | | Game Video Analysis | |
| Mental Preparation | | Mental Preparation | |
| Technique | | Technique | |
| Weights | | Weights | |
| Work with a Coach | | Work with a Coach | |
| **Quad Rugby Related** | **Minutes per Week** | **Daily Life Activities** | **Minutes per Week** |
| Conversing about Quad Rugby | | Active Leisure | |
| Coaching Quad Rugby | | Non-Active Leisure | |
| Diet/Nutritional Planning | | Eating/Snacking | |
| Physiotherapy | | Studying/Sleeping | |
| Reading Quad Rugby Material | | Household Duties | |
| Training Journal | | Transportation/Commuting | |
| Organization and Preparation | | Body Care and Health | |
| Watching Quad Rugby | | | |

| 2 Years Later | | | |
|---|---|---|---|
| Age = | | | |
| **Individual Practice Activities** | **Minutes per Week** | **Team Practice Activities** | **Minutes per Week** |
| Cardiovascular Training | | Cardiovascular Training | |
| Flexibility | | Flexibility | |
| Game Video Analysis | | Game Video Analysis | |
| Mental Preparation | | Mental Preparation | |
| Technique | | Technique | |
| Weights | | Weights | |
| Work with a Coach | | Work with a Coach | |
| **Quad Rugby Related** | **Minutes per Week** | **Daily Life Activities** | **Minutes per Week** |
| Conversing about Quad Rugby | | Active Leisure | |
| Coaching Quad Rugby | | Non-Active Leisure | |
| Diet/Nutritional Planning | | Eating/Snacking | |
| Physiotherapy | | Studying/Sleeping | |
| Reading Quad Rugby Material | | Household Duties | |
| Training Journal | | Transportation/Commuting | |
| Organization and Preparation | | Body Care and Health | |
| Watching Quad Rugby | | | |

| 4 Years Later | | | |
|---|---|---|---|
| Age = | | | |
| **Individual Practice Activities** | **Minutes per Week** | **Team Practice Activities** | **Minutes per Week** |
| Cardiovascular Training | | Cardiovascular Training | |
| Flexibility | | Flexibility | |
| Game Video Analysis | | Game Video Analysis | |
| Mental Preparation | | Mental Preparation | |
| Technique | | Technique | |
| Weights | | Weights | |
| Work with a Coach | | Work with a Coach | |
| **Quad Rugby Related** | **Minutes per Week** | **Daily Life Activities** | **Minutes per Week** |
| Conversing about Quad Rugby | | Active Leisure | |
| Coaching Quad Rugby | | Non-Active Leisure | |
| Diet/Nutritional Planning | | Eating/Snacking | |
| Physiotherapy | | Studying/Sleeping | |
| Reading Quad Rugby Material | | Household Duties | |
| Training Journal | | Transportation/Commuting | |
| Organization and Preparation | | Body Care and Health | |
| Watching Quad Rugby | | | |

| 6 Years Later | | | |
|---|---|---|---|
| Age = | | | |
| **Individual Practice Activities** | **Minutes per Week** | **Team Practice Activities** | **Minutes per Week** |
| Cardiovascular Training | | Cardiovascular Training | |
| Flexibility | | Flexibility | |
| Game Video Analysis | | Game Video Analysis | |
| Mental Preparation | | Mental Preparation | |
| Technique | | Technique | |
| Weights | | Weights | |
| Work with a Coach | | Work with a Coach | |
| **Quad Rugby Related** | **Minutes per Week** | **Daily Life Activities** | **Minutes per Week** |
| Conversing about Quad Rugby | | Active Leisure | |
| Coaching Quad Rugby | | Non-Active Leisure | |
| Diet/Nutritional Planning | | Eating/Snacking | |
| Physiotherapy | | Studying/Sleeping | |
| Reading Quad Rugby Material | | Household Duties | |
| Training Journal | | Transportation/Commuting | |
| Organization and Preparation | | Body Care and Health | |
| Watching Quad Rugby | | | |

| 8 Years Later | | | |
|---|---|---|---|
| Age = | | | |
| **Individual Practice Activities** | **Minutes per Week** | **Team Practice Activities** | **Minutes per Week** |
| Cardiovascular Training | | Cardiovascular Training | |
| Flexibility | | Flexibility | |
| Game Video Analysis | | Game Video Analysis | |
| Mental Preparation | | Mental Preparation | |
| Technique | | Technique | |
| Weights | | Weights | |
| Work with a Coach | | Work with a Coach | |
| **Quad Rugby Related** | **Minutes per Week** | **Daily Life Activities** | **Minutes per Week** |
| Conversing about Quad Rugby | | Active Leisure | |
| Coaching Quad Rugby | | Non-Active Leisure | |
| Diet/Nutritional Planning | | Eating/Snacking | |
| Physiotherapy | | Studying/Sleeping | |
| Reading Quad Rugby Material | | Household Duties | |
| Training Journal | | Transportation/Commuting | |
| Organization and Preparation | | Body Care and Health | |
| Watching Quad Rugby | | | |

| 10 Years Later | | | |
|---|---|---|---|
| Age = | | | |
| **Individual Practice Activities** | **Minutes per Week** | **Team Practice Activities** | **Minutes per Week** |
| Cardiovascular Training | | Cardiovascular Training | |
| Flexibility | | Flexibility | |
| Game Video Analysis | | Game Video Analysis | |
| Mental Preparation | | Mental Preparation | |
| Technique | | Technique | |
| Weights | | Weights | |
| Work with a Coach | | Work with a Coach | |
| **Quad Rugby Related** | **Minutes per Week** | **Daily Life Activities** | **Minutes per Week** |
| Conversing about Quad Rugby | | Active Leisure | |
| Coaching Quad Rugby | | Non-Active Leisure | |
| Diet/Nutritional Planning | | Eating/Snacking | |
| Physiotherapy | | Studying/Sleeping | |
| Reading Quad Rugby Material | | Household Duties | |
| Training Journal | | Transportation/Commuting | |
| Organization and Preparation | | Body Care and Health | |
| Watching Quad Rugby | | | |

| 12 Years Later | | | |
|---|---|---|---|
| Age = | | | |
| **Individual Practice Activities** | **Minutes per Week** | **Team Practice Activities** | **Minutes per Week** |
| Cardiovascular Training | | Cardiovascular Training | |
| Flexibility | | Flexibility | |
| Game Video Analysis | | Game Video Analysis | |
| Mental Preparation | | Mental Preparation | |
| Technique | | Technique | |
| Weights | | Weights | |
| Work with a Coach | | Work with a Coach | |
| **Quad Rugby Related** | **Minutes per Week** | **Daily Life Activities** | **Minutes per Week** |
| Conversing about Quad Rugby | | Active Leisure | |
| Coaching Quad Rugby | | Non-Active Leisure | |
| Diet/Nutritional Planning | | Eating/Snacking | |
| Physiotherapy | | Studying/Sleeping | |
| Reading Quad Rugby Material | | Household Duties | |
| Training Journal | | Transportation/Commuting | |
| Organization and Preparation | | Body Care and Health | |
| Watching Quad Rugby | | | |

| 14 Years Later | | | |
|---|---|---|---|
| Age = | | | |
| **Individual Practice Activities** | **Minutes per Week** | **Team Practice Activities** | **Minutes per Week** |
| Cardiovascular Training | | Cardiovascular Training | |
| Flexibility | | Flexibility | |
| Game Video Analysis | | Game Video Analysis | |
| Mental Preparation | | Mental Preparation | |
| Technique | | Technique | |
| Weights | | Weights | |
| Work with a Coach | | Work with a Coach | |
| **Quad Rugby Related** | **Minutes per Week** | **Daily Life Activities** | **Minutes per Week** |
| Conversing about Quad Rugby | | Active Leisure | |
| Coaching Quad Rugby | | Non-Active Leisure | |
| Diet/Nutritional Planning | | Eating/Snacking | |
| Physiotherapy | | Studying/Sleeping | |
| Reading Quad Rugby Material | | Household Duties | |
| Training Journal | | Transportation/Commuting | |
| Organization and Preparation | | Body Care and Health | |
| Watching Quad Rugby | | | |

**Duration of off-season**

What was the duration of your off-season (time not training for any type of quad rugby) at different times throughout your career? Use only the columns that you need.

| | Start Age | 2 Yrs Later | 4 Yrs Later | 6Yrs Later | 8 Yrs Later | 10 Yrs Later | 12 Yrs Later | 14 Yrs Later |
|---|---|---|---|---|---|---|---|---|
| Duration (weeks) | | | | | | | | |
| | 16 Yrs Later | 18 Yrs Later | 20Yrs Later | 22 Yrs Later | 24 Yrs Later | 26 Yrs Later | 28 Yrs Later | 30 Yrs Later |
| Duration (weeks) | | | | | | | | |

**Part II**

Next, you will be asked questions about the training activities you have already seen. The following sections are divided into:

1. Individual practice activities
2. Team practice activities
3. Quad rugby related activities
4. Daily life activities

Please take a moment to refresh your understanding of each of the activity labels before completing each section.

**"Rating your Practice"**

On the following pages there are charts of activities. Please rate each of the activities on the following four dimensions:

1. **Relevance** – the relevance of the activity to improving quad rugby performance

2. **Effort** – how much physical effort is required to perform the activity

3. **Concentration** – how much concentration or mental effort is required to perform the activity.

4. **Enjoyment** – how enjoyable the activity actually is. Please note that you are rating your actual participation in the activity, not the consequences of that activity. For example, if we asked you to rate the enjoyment of household cleaning, the rating of the actual chose of cleaning would be lover than the consequences of the activity – a clean house. Keep this in mind when filling out the chart.

For the purpose of rating, use a 10-point scale for all the activities.

For relevance, a "0" implies no relevance and a "10" means the activity is the most relevant to improving quad rugby performance.

For effort, a "0" implies that no physical effort is required to perform the activity and a "10" means that the activity is extremely effortful.

For enjoyment, a "0" implies that the activity is not at all enjoyable and a "10" means that the activity is very enjoyable.

For concentration, a "0" implies that the activity requires no concentration and a "10" means that the activity demands very high levels of concentration.

If you do not engage in the activity label, please write Not Applicable or NA.

| Individual Practice Activity | Relevance to Improving Quad Rugby Performance 0 = no relevance 10 = highly relevant | Effort Required to Perform the Activity 0 = no relevance 10 = highly relevant | How Enjoyable the Activity is 0 = no relevance 10 = highly relevant | How Much Concentration is Required to Perform the Activity 0 = no relevance 10 = highly relevant |
|---|---|---|---|---|
| Cardiovascular Training | | | | |
| Flexibility | | | | |
| Game Video Analysis | | | | |
| Mental Preparation | | | | |
| Technique | | | | |
| Weight Training | | | | |
| Work with a Coach | | | | |

| Team Practice Activity | Relevance to Improving Quad Rugby Performance 0 = no relevance 10 = highly relevant | Effort Required to Perform the Activity 0 = no relevance 10 = highly relevant | How Enjoyable the Activity is 0 = no relevance 10 = highly relevant | How Much Concentration is Required to Perform the Activity 0 = no relevance 10 = highly relevant |
|---|---|---|---|---|
| Cardiovascular Training | | | | |
| Flexibility | | | | |
| Game Video Analysis | | | | |
| Mental Preparation | | | | |
| Technique | | | | |
| Weight Training | | | | |
| Work with a Coach | | | | |

| Quad Rugby Related Activity | Relevance to Improving Quad Rugby Performance 0 = no relevance 10 = highly relevant | Effort Required to Perform the Activity 0 = no relevance 10 = highly relevant | How Enjoyable the Activity is 0 = no relevance 10 = highly relevant | How Much Concentration is Required to Perform the Activity 0 = no relevance 10 = highly relevant |
|---|---|---|---|---|
| Conversing about Quad Rugby | | | | |
| Coaching Quad Rugby | | | | |
| Diet/Nutritional Planning | | | | |
| Physiotherapy | | | | |
| Reading Quad Rugby Material | | | | |
| Training Journal | | | | |
| Organization and Preparation | | | | |

| Daily Life Activity | Relevance to Improving Quad Rugby Performance 0 = no relevance 10 = highly relevant | Effort Required to Perform the Activity 0 = no relevance 10 = highly relevant | How Enjoyable the Activity is 0 = no relevance 10 = highly relevant | How Much Concentration is Required to Perform the Activity 0 = no relevance 10 = highly relevant |
|---|---|---|---|---|
| Active Leisure | | | | |
| Nonactive Leisure | | | | |
| Eating/Snacking | | | | |
| Sleeping | | | | |
| Studying/Working | | | | |
| Household Duties | | | | |
| Transportation and Commuting | | | | |
| Body Care and Health | | | | |

**Appendix E: Survey Instructions**

**Survey Flow and Instructions**

**Prior to Data Collection Session:**

1. Investigator will provide information to Coach Orr with basic information for the participants about the study, the length of time required for the survey, and the importance of bringing training logs. Coach Orr will compose a contact list of those who are interested and willing to be participants in the study.
2. Investigator will use the contact list composed by Coach Orr to make initial contact with participants. Participants will be contacted via phone or email. The investigator will schedule a time to meet in-person to administer the informed consent and study survey. During initial contact participants will be informed of the purpose of the study and what to bring to the meeting (e.g. training logs).
3. Participants will be sent email reminders of the date of their one-on-one meeting and to bring their training logs to the meeting.

**Data Collection Session:**

1. Investigator will introduce herself to participants and provide the purpose of this study as stated in the Informed Consent.
2. Investigator will determine if participant needs assistance in completing the questionnaire.
3. Participants will be asked to read and sign the informed consent form and the investigator will provide them with a blank copy of the consent form to keep.

**Part I**

1. Biographical information
    a. Investigator: "The first section of the survey is going to ask questions about you and your disability. It is also going to ask questions about when you began to participate in quad rugby. If you have any questions I will be available to answer them at anytime"
    b. Participant completes biographical information **(pg.1-2)**
2. Time spent in training
    a. Investigator: "You are encouraged to use your training log to help you remember the amount of time that you have spent training for quad rugby since beginning practice. You will be recalling the amount of time that you spent in each of these activities since beginning practice. These four sheets are color coded for each section. The pink sheet contains individual practice activities, the yellow sheet contains team practice activities, the green sheet contains quad rugby related activities, and the blue sheet contains daily life activities. These sheets will be available to you the entire meeting. Please take a moment to read and understand each of the following activity labels."
    b. Participant read definitions **(pg.2)**
    c. Investigator: "Do you have any questions about the activity labels?"
    d. Investigator: "On this page, **page 3,** it is described how to record the amount of time that you have spent practicing for quad rugby. Please use your personal training logs to complete the following activity. By using your training logs you ensure that your information is accurate.

We are interested in finding out what a "typical week" of training was like for you at different times in your quad rugby career. When you think of a "typical week", try to consider one occurring during the competitive phase of the quad rugby season. More specifically, consider a "typical training week" that is 10 weeks prior to your major quad rugby championship.

e. On the next page there is a chart with columns corresponding to different periods of your quad rugby career.

f. Investigator will turn to **page 4** – so that the chart is visible

g. Investigator: "Please write underneath the column headings the ages you were at the specific times. Start Age should be the age when you first began to regularly practice quad rugby with a coach. For example, if you started training at age 14, write Age=14 beneath the "Start Age" column, and Age=16 beneath the "2 Years Later" column, and so on. You may find that you will not need all the columns. If you have been training for more than 14 years you will require an additional chart on the following page. Please stop when you reach the column corresponding to the age you are now (or the nearest to it)."

h. Investigator: "Each of the rows on the chart refers to a training activity. Recall the average time (in minutes) in a typical week you spent practicing that activity at various periods of your quad rugby career."

i. Investigator: "It is very important that you take your time and consider each time period and activity thoroughly. Again, if you have access to personal training logs, please consult them in order to complete this activity. If you have any questions about this section of the survey, I will be available to answer them."

j. Participant completes **page 4-11**

3. Off Season Information
    a. Investigator: "Next you are going to fill out the length of your off season or the amount of time that you were not training for quad rugby throughout the same year periods across your career. This is the chart that you will put the appropriate amount of time in for every 2 year period. Please use only the blocks that you need."
    b. Participant completes **page 12**
4. **If additional sport were played at a competitive level, time spent in training charts will also be filled out for these sports after completion of quad rugby charts.**

**Part II**

1. Explain Part II of the questionnaire **(pg.13)**
    a. Investigator: "In Part II you will be asked questions about the training activities you have already seen. Part II is divided into four charts: individual practice activities, team practice activities, quad rugby related activities, and daily life activities.

**Individual Practice Activities**

1. First, we are going to look at individual practice activities. Please take a moment to read and understand the following individual practice activity labels (pink sheet of definitions)."
2. Participant reads the labels for individual practice activities.
3. Investigator: "Do you have any questions about these labels?"
4. Investigator: "You will be rating each of these labels on four dimensions."

a. **Relevance** – the relevance of the activity to improving quad rugby performance

b. **Effort** – how much physical effort is required to perform the activity

c. **Enjoyment** – how enjoyable the activity actually is. Please note that you are rating your actual participation in the activity, not the consequences of that activity. For example, if we asked you to rate the enjoyment of household cleaning, the rating of the actual chose of cleaning would be lover than the consequences of the activity – a clean house. Keep this in mind when filling out the chart.

d. **Concentration** – how much concentration or mental effort is required to perform the activity

5. Investigator: "For the purpose of rating, use a 10-point scale for all the activities."
    a. For relevance, a "0" implies no relevance and a "10" means the activity is the most relevant to improving quad rugby performance
    b. For effort, a "0" implies that no physical effort is required to perform the activity and a "10" means that the activity is extremely effortful.
    c. For enjoyment, a "0" implies that the activity is not at all enjoyable and a "10" means that the activity is very enjoyable.
    d. For concentration, a "0" implies that the activity requires no concentration and a "10" means that the activity demands very high levels of concentration
    e. If you do not engage in the activity label, please write Not Applicable or NA.
6. Investigator: "Do you have any questions about the rating scale?"
7. Participant completes **pg. 14** – chart on individual practice activities

**Team Practice Activities**

1. Investigator: "Next, we are going to look at team practice activities that you participate in. Please take a moment to read and understand the following team practice activity labels (yellow sheet of definitions)"
2. Participant reads the labels on the yellow definition sheet.
3. Investigator: "Do you have any questions about these labels?"
4. Investigator: "You will be rating these activities on the same practice rating scale as in the previous chart, looking at relevance effort, enjoyment and concentration. **Page 13** provides the definition of these terms again if you need to reference them"
5. Participant completes **page 15** – chart on team practice activities

**Quad Rugby Related Activities**

1. Investigator: "Next, we are going to look at quad rugby related activities that you participate in. Please take a moment to read and understand the following team practice activity labels (green sheet of definitions)"
2. Participant reads the labels on the green definition sheet.
3. Investigator: "Do you have any questions about these labels?"
4. Investigator: "You will be rating these activities on the same practice rating scale as before, looking at relevance effort, enjoyment and concentration. **Page 13** provides the definition of these terms again if you need to reference them"
5. Participant completes **page 16** – chart on team practice activities

**Daily Life Activities**

1. Investigator: "Next, we are going to look at daily life activities that you engage in. Please take a moment to read and understand the following daily life activity labels (blue sheet of definitions)"
2. Participant reads labels on the blue definition sheet.
3. Investigator: "Do you have any questions about these labels?"
4. Investigator: "You will be rating these activities on the same practice rating scale as before, looking at relevance effort, enjoyment and concentration. **Page 13** provides the definition of these terms again if you need to reference them"
5. Participant completes **page 17** – chart on team practice activities

Upon completion of the survey, participant will be thanked by the investigator for their participation in the study and the time that they have dedicated to it.

## Appendix F: Statistical Result Tables for Paired Comparisons

**Table F1**

*Statistical Results for Paired Comparisons of Mean and Grand Mean based on Ratings of Relevance of Individual Practice Activities*

| Individual Practice | Relevance Statistics | | | | | | |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | $\overline{\overline{X}}$ | *SD of* $\overline{\overline{X}}$ | *t* | *df* [1] | *p* |
| Cardiovascular | 10.00 | 0.00 | 7.65 | 0.60 | 12.389 | 9 | .000 |
| Flexibility | 7.40 | 2.22 | 7.65 | 0.60 | -.389 | 9 | .706 |
| Game Analysis | 6.33 | 0.82 | 7.62 | 0.30 | -3.606 | 5 | .015 |
| Mental Preparation | 8.57 | 1.13 | 7.69 | 0.32 | 1.741 | 6 | .132 |
| Technique | 9.50 | 0.71 | 7.65 | 0.60 | 8.682 | 9 | .000 |
| Weights | 8.50 | 2.17 | 7.65 | 0.60 | 1.213 | 9 | .256 |
| Work with Coach | 9.38 | 0.74 | 7.66 | 0.68 | 6.470 | 7 | .000 |

*Note.* Statistical significance ($p \leq .002$) was determined using adjusted alpha levels according to Bonferroni's correction.

[1]Number of respondents varied for different items, so *df* reflect number of responding participants for each pair wise comparison.

$\overline{\overline{X}}$ = *grand mean.*

**Table F2**

*Statistical Results for Paired Comparisons of Mean and Grand Mean based on Ratings of Effort of Individual Practice Activities*

| Individual Practice | Effort Statistics | | | | | | |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | $\overline{\overline{X}}$ | *SD of* $\overline{\overline{X}}$ | *t* | *df* [1] | *p* |
| Cardiovascular | 9.40 | 0.97 | 6.00 | 1.46 | 6.992 | 9 | .000 |
| Flexibility | 4.10 | 3.18 | 6.00 | 1.46 | -3.246 | 9 | .010 |
| Game Analysis | 4.86 | 2.27 | 6.63 | 1.16 | -1.604 | 6 | .160 |
| Mental Preparation | 5.29 | 3.40 | 6.63 | 1.16 | -1.161 | 6 | .290 |
| Technique | 8.60 | 1.65 | 6.00 | 1.46 | 6.804 | 9 | .000 |
| Weights | 8.60 | 2.22 | 6.00 | 1.46 | 2.809 | 9 | .020 |
| Work with Coach | 6.38 | 4.14 | 6.09 | 1.17 | .256 | 7 | .805 |

*Note.* Statistical significance ($p \leq .002$) was determined using adjusted alpha levels according to Bonferroni's correction.

[1]Number of respondents varied for different items, so *df* reflect number of responding participants for each pair wise comparison.

$\overline{\overline{X}}$ = *grand mean.*

**Table F3**

*Statistical Results for Paired Comparisons of Mean and Grand Mean based on Ratings of Enjoyment of Individual Practice Activities*

| Individual Practice | Enjoyment Statistics | | | | | | |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | $\overline{\overline{X}}$ | *SD of* $\overline{\overline{X}}$ | *t* | *df* [1] | *p* |
| Cardiovascular | 5.00 | 3.65 | 6.23 | 1.08 | -1.311 | 9 | .222 |
| Flexibility | 4.60 | 3.50 | 6.23 | 1.08 | -1.619 | 9 | .140 |
| Game Analysis | 4.43 | 1.90 | 6.56 | 1.14 | -3.445 | 6 | .014 |
| Mental Preparation | 7.29 | 1.60 | 6.56 | 1.14 | 1.365 | 6 | .221 |
| Technique | 7.30 | 2.45 | 6.23 | 1.08 | 1.868 | 9 | .095 |
| Weights | 6.10 | 2.88 | 6.23 | 1.08 | -.156 | 9 | .880 |
| Work with Coach | 6.75 | 3.20 | 6.13 | 1.10 | .614 | 7 | .559 |

*Note.* Statistical significance ($p \leq .002$) was determined using adjusted alpha levels according to Bonferroni's correction.

[1]Number of respondents varied for different items, so *df* reflect number of responding participants for each pair wise comparison.

$\overline{\overline{X}}$ = *grand mean.*

**Table F4**

*Statistical Results for Paired Comparisons of Mean and Grand Mean based on Ratings of Concentration of Individual Practice Activities*

| Individual Practice | Concentration Statistics | | | | | | |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | $\overline{\overline{X}}$ | *SD of* $\overline{\overline{X}}$ | *t* | *df* [1] | *p* |
| Cardiovascular | 7.10 | 2.03 | 5.86 | 1.32 | 1.784 | 9 | .108 |
| Flexibility | 3.00 | 3.02 | 5.86 | 1.32 | -4.618 | 9 | .001 |
| Game Analysis | 7.00 | 2.89 | 6.41 | 1.07 | .498 | 6 | .636 |
| Mental Preparation | 9.57 | 0.79 | 6.41 | 1.07 | 5.498 | 6 | .002 |
| Technique | 8.70 | 1.64 | 5.86 | 1.32 | 4.492 | 9 | .002 |
| Weights | 6.60 | 2.91 | 5.86 | 1.32 | .866 | 9 | .409 |
| Work with Coach | 8.88 | 1.25 | 5.95 | 1.06 | 7.066 | 7 | .000 |

*Note.* Statistical significance ($p \leq .002$) was determined using adjusted alpha levels according to Bonferroni's correction.

[1]Number of respondents varied for different items, so *df* reflect number of responding participants for each pair wise comparison.

$\overline{\overline{X}}$ = *grand mean.*

**Table F5**

*Statistical Results for Paired Comparisons of Mean and Grand Mean based on Ratings of Relevance of Team Practice Activities*

| Team Practice | Relevance Statistics | | | | | | |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | $\overline{\overline{X}}$ | *SD of* $\overline{\overline{X}}$ | *t* | *df* [1] | *p* |
| Cardiovascular | 10.00 | 0.00 | 7.65 | 0.60 | 12.389 | 9 | .000 |
| Flexibility | 7.33 | 2.06 | 7.60 | 0.62 | -.432 | 8 | .677 |
| Game Analysis | 7.50 | 0.58 | 7.75 | 0.23 | -.634 | 3 | .571 |
| Mental Preparation | 7.17 | 1.72 | 7.48 | 0.58 | -.440 | 5 | .678 |
| Technique | 9.10 | 0.88 | 7.65 | 0.60 | 4.875 | 9 | .001 |
| Weights | 8.00 | 3.37 | 7.67 | 0.16 | .199 | 3 | .855 |
| Work with Coach | 9.80 | 0.42 | 7.65 | 0.60 | 14.205 | 9 | .000 |

*Note.* Statistical significance ($p \leq .002$) was determined using adjusted alpha levels according to Bonferroni's correction.

[1]Number of respondents varied for different items, so *df* reflect number of responding participants for each pair wise comparison.

$\overline{\overline{X}}$ = *grand mean.*

**Table F6**

*Statistical Results for Paired Comparisons of Mean and Grand Mean based on Ratings of Effort of Team Practice Activities*

| Team Practice | Effort Statistics | | | | | | |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | $\overline{\overline{X}}$ | *SD of* $\overline{\overline{X}}$ | *t* | *df* [1] | *p* |
| Cardiovascular | 9.00 | 1.49 | 6.00 | 1.46 | 7.753 | 9 | .000 |
| Flexibility | 4.67 | 2.96 | 5.85 | 1.47 | -1.827 | 8 | .105 |
| Game Analysis | 5.75 | 3.59 | 7.15 | 0.58 | -.874 | 3 | .447 |
| Mental Preparation | 4.67 | 2.66 | 6.56 | 1.12 | -2.496 | 5 | .055 |
| Technique | 7.90 | 1.52 | 6.00 | 1.46 | 4.620 | 9 | .001 |
| Weights | 8.75 | 1.89 | 6.38 | 1.97 | 5.562 | 3 | .011 |
| Work with Coach | 6.40 | 3.81 | 6.00 | 1.46 | .432 | 9 | .676 |

*Note.* Statistical significance ($p \leq .002$) was determined using adjusted alpha levels according to Bonferroni's correction.

[1]Number of respondents varied for different items, so *df* reflect number of responding participants for each pair wise comparison.

$\overline{\overline{X}}$ = *grand mean.*

**Table F7**

*Statistical Results for Paired Comparisons of Mean and Grand Mean based on Ratings of Enjoyment of Team Practice Activities*

| Team Practice | Enjoyment Statistics | | | | | | |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | $\overline{\overline{X}}$ | *SD of* $\overline{\overline{X}}$ | *t* | *df* [1] | *p* |
| Cardiovascular | 6.20 | 2.82 | 6.23 | 1.08 | -.048 | 9 | .963 |
| Flexibility | 4.67 | 3.16 | 6.20 | 1.14 | -1.752 | 8 | .118 |
| Game Analysis | 6.50 | 1.73 | 7.17 | 0.44 | -.943 | 3 | .415 |
| Mental Preparation | 5.17 | 2.48 | 6.79 | 0.74 | -1.818 | 5 | .129 |
| Technique | 6.40 | 2.50 | 6.23 | 1.08 | .291 | 9 | .778 |
| Weights | 6.25 | 2.22 | 6.92 | 0.86 | -.743 | 3 | .511 |
| Work with Coach | 7.70 | 1.83 | 6.23 | 1.08 | 2.704 | 9 | .024 |

*Note.* Statistical significance ($p \leq .002$) was determined using adjusted alpha levels according to Bonferroni's correction.

[1]Number of respondents varied for different items, so *df* reflect number of responding participants for each pair wise comparison.

$\overline{\overline{X}}$ = *grand mean.*

**Table F8**

*Statistical Results for Paired Comparisons of Mean and Grand Mean based on Ratings of Concentration of Team Practice Activities*

| Team Practice | Concentration Statistics | | | | | | |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | $\overline{\overline{X}}$ | *SD of* $\overline{\overline{X}}$ | *t* | *df* [1] | *p* |
| Cardiovascular | 7.20 | 2.97 | 5.86 | 1.32 | 1.673 | 9 | .129 |
| Flexibility | 3.22 | 2.86 | 5.85 | 1.40 | -4.887 | 8 | .001 |
| Game Analysis | 7.25 | 1.50 | 7.08 | 0.73 | .191 | 3 | .861 |
| Mental Preparation | 7.50 | 1.64 | 6.53 | 1.08 | 1.322 | 5 | .243 |
| Technique | 8.00 | 1.49 | 5.86 | 1.32 | 3.928 | 9 | .003 |
| Weights | 7.25 | 2.87 | 6.47 | 1.95 | 1.627 | 3 | .202 |
| Work with Coach | 8.90 | 1.20 | 5.86 | 1.32 | 10.383 | 9 | .000 |

*Note.* Statistical significance ($p \leq .002$) was determined using adjusted alpha levels according to Bonferroni's correction.

[1]Number of respondents varied for different items, so *df* reflect number of responding participants for each pair wise comparison.

$\overline{\overline{X}}$ = *grand mean.*

**Table F9**

*Statistical Results for Paired Comparisons of Mean and Grand Mean based on Ratings of Relevance of Quad Rugby Related Activities*

| Quad Rugby Related | Relevance Statistics | | | | | | |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | $\overline{\overline{X}}$ | *SD of* $\overline{\overline{X}}$ | *t* | *df* [1] | *p* |
| Conversing about QR | 7.30 | 1.77 | 7.65 | 0.60 | -.630 | 9 | .544 |
| Coaching QR | 9.33 | 1.16 | 7.67 | 0.20 | 2.127 | 2 | .167 |
| Diet Planning | 8.13 | 1.13 | 7.52 | 0.55 | 1.700 | 7 | .133 |
| Physiotherapy | 6.75 | 2.36 | 7.53 | 0.30 | -.654 | 3 | .560 |
| Reading about QR | 5.75 | 3.95 | 7.76 | 0.28 | -.961 | 3 | .407 |
| Training Journal | 8.33 | 0.58 | 7.81 | 0.24 | 1.104 | 2 | .385 |
| Organization/Preparation | 8.71 | 1.11 | 7.70 | 0.32 | 2.196 | 6 | .070 |
| Watching QR | 9.20 | 1.30 | 7.94 | 0.46 | 2.693 | 4 | .055 |

*Note.* Statistical significance ($p \leq .002$) was determined using adjusted alpha levels according to Bonferroni's correction.

[1]Number of respondents varied for different items, so *df* reflect number of responding participants for each pair wise comparison.

$\overline{\overline{X}}$ = *grand mean.*

**Table F10**

*Statistical Results for Paired Comparisons of Mean and Grand Mean based on Ratings of Effort of Quad Rugby Related Activities*

| Quad Rugby Related | Effort Statistics | | | | | | |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | $\overline{\overline{X}}$ | *SD of* $\overline{\overline{X}}$ | *t* | *df* [1] | *p* |
| Conversing about QR | 5.80 | 3.52 | 6.00 | 1.46 | -.225 | 9 | .827 |
| Coaching QR | 8.33 | 1.53 | 6.78 | 0.65 | 2.991 | 2 | .096 |
| Diet Planning | 8.25 | 1.17 | 6.38 | 1.28 | 2.792 | 7 | .027 |
| Physiotherapy | 6.00 | 3.92 | 6.27 | 1.46 | -.173 | 3 | .874 |
| Reading about QR | 5.25 | 2.36 | 7.02 | 0.74 | -1.345 | 3 | .271 |
| Training Journal | 7.00 | 2.00 | 7.06 | 0.67 | -.075 | 2 | .947 |
| Organization/Preparation | 7.29 | 2.43 | 6.07 | 1.58 | 2.659 | 6 | .038 |
| Watching QR | 7.40 | 4.34 | 6.71 | 0.94 | .396 | 4 | .712 |

*Note.* Statistical significance ($p \leq .002$) was determined using adjusted alpha levels according to Bonferroni's correction.

[1]Number of respondents varied for different items, so *df* reflect number of responding participants for each pair wise comparison.

$\overline{\overline{X}}$ = *grand mean.*

**Table F11**

*Statistical Results for Paired Comparisons of Mean and Grand Mean based on Ratings of Enjoyment of Quad Rugby Related Activities*

| Quad Rugby Related | Enjoyment Statistics | | | | | | |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | $\overline{\overline{X}}$ | *SD of* $\overline{\overline{X}}$ | *t* | *df* [1] | *p* |
| Conversing about QR | 6.70 | 2.71 | 6.23 | 1.08 | .655 | 9 | .529 |
| Coaching QR | 9.00 | 1.00 | 6.97 | 0.55 | 4.492 | 2 | .046 |
| Diet Planning | 5.00 | 2.83 | 6.44 | 1.11 | -2.070 | 7 | .077 |
| Physiotherapy | 8.50 | 1.73 | 6.44 | 1.59 | 1.474 | 3 | .237 |
| Reading about QR | 6.50 | 4.51 | 7.04 | 0.59 | -.252 | 3 | .817 |
| Training Journal | 7.67 | 1.15 | 7.27 | 0.48 | .666 | 2 | .574 |
| Organization/Preparation | 5.43 | 1.72 | 6.40 | 1.17 | -1.402 | 6 | .211 |
| Watching QR | 6.80 | 3.42 | 6.65 | 1.01 | .114 | 4 | .914 |

*Note.* Statistical significance ($p \leq .002$) was determined using adjusted alpha levels according to Bonferroni's correction.

[1]Number of respondents varied for different items, so *df* reflect number of responding participants for each pair wise comparison.

$\overline{\overline{X}}$ = *grand mean.*

**Table F12**

*Statistical Results for Paired Comparisons of Mean and Grand Mean based on Ratings of Concentration of Quad Rugby Related Activities*

| Quad Rugby Related | Concentration Statistics | | | | | | |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | $\overline{\overline{X}}$ | *SD of* $\overline{\overline{X}}$ | *t* | *df* [1] | *p* |
| Conversing about QR | 5.70 | 2.91 | 5.86 | 1.32 | -.160 | 9 | .877 |
| Coaching QR | 9.33 | 1.15 | 6.95 | 0.87 | 11.848 | 2 | .007 |
| Diet Planning | 7.63 | 1.30 | 6.22 | 1.13 | 2.985 | 7 | .020 |
| Physiotherapy | 3.25 | 3.95 | 6.33 | 1.30 | -2.142 | 3 | .122 |
| Reading about QR | 5.00 | 3.37 | 6.65 | 0.80 | -1.150 | 3 | .333 |
| Training Journal | 6.67 | 2.08 | 6.90 | 0.78 | -.208 | 2 | .854 |
| Organization/Preparation | 6.14 | 2.91 | 5.83 | 1.37 | .416 | 6 | .692 |
| Watching QR | 7.00 | 2.12 | 6.38 | 0.93 | .563 | 4 | .603 |

*Note.* Statistical significance ($p \leq .002$) was determined using adjusted alpha levels according to Bonferroni's correction.

[1]Number of respondents varied for different items, so *df* reflect number of responding participants for each pair wise comparison.

$\overline{\overline{X}}$ = *grand mean.*

**Table F13**

*Statistical Results for Paired Comparisons of Mean and Grand Mean based on Ratings of Relevance of Daily Life Activities*

| Daily Life Activities | Relevance Statistics | | | | | | |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | $\overline{\overline{X}}$ | *SD of* $\overline{\overline{X}}$ | *t* | *df* [1] | *p* |
| Active Leisure | 6.33 | 4.12 | 7.65 | 0.64 | -.971 | 8 | .360 |
| Nonactive Leisure | 3.80 | 4.19 | 7.65 | 0.60 | -3.030 | 9 | .014 |
| Snacking | 7.60 | 1.65 | 7.65 | 0.60 | -.123 | 9 | .905 |
| Sleeping | 8.80 | 1.48 | 7.65 | 0.60 | 2.799 | 9 | .021 |
| Work/Studying | 6.78 | 3.19 | 7.79 | 0.42 | -9.89 | 8 | .352 |
| Household Duties | 1.67 | 2.60 | 7.65 | 0.64 | -7.287 | 8 | .000 |
| Transportation | 5.20 | 4.52 | 7.65 | 0.60 | -1.825 | 9 | .101 |
| Body Care | 7.70 | 2.58 | 7.65 | 0.60 | .065 | 9 | .950 |

*Note.* Statistical significance ($p \leq .002$) was determined using adjusted alpha levels according to Bonferroni's correction.

[1]Number of respondents varied for different items, so *df* reflect number of responding participants for each pair wise comparison.

$\overline{\overline{X}}$ = *grand mean.*

**Table F14**

*Statistical Results for Paired Comparisons of Mean and Grand Mean based on Ratings of Effort of Daily Life Activities*

| Daily Life Activities | Effort Statistics | | | | | | |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | $\overline{\overline{X}}$ | *SD of* $\overline{\overline{X}}$ | *t* | *df* [1] | *p* |
| Active Leisure | 5.22 | 2.73 | 5.84 | 1.46 | -.778 | 8 | .459 |
| Nonactive Leisure | 2.60 | 3.41 | 6.00 | 1.46 | -3.820 | 9 | .004 |
| Snacking | 4.70 | 2.75 | 6.00 | 1.46 | -1.767 | 9 | .111 |
| Sleeping | 3.70 | 4.22 | 6.00 | 1.46 | -2.030 | 9 | .073 |
| Work/Studying | 6.56 | 3.00 | 6.15 | 1.46 | .333 | 8 | .748 |
| Household Duties | 4.56 | 3.28 | 6.28 | 1.24 | -1.682 | 8 | .131 |
| Transportation | 4.50 | 3.21 | 6.00 | 1.46 | -1.906 | 9 | .089 |
| Body Care | 5.90 | 2.42 | 6.00 | 1.46 | -.165 | 9 | .873 |

*Note.* Statistical significance ($p \leq .002$) was determined using adjusted alpha levels according to Bonferroni's correction.

[1]Number of respondents varied for different items, so *df* reflect number of responding participants for each pair wise comparison.

$\overline{\overline{X}}$ = *grand mean.*

**Table F15**

*Statistical Results for Paired Comparisons of Mean and Grand Mean based on Ratings of Enjoyment of Daily Life Activities*

| Daily Life Activities | Enjoyment Statistics | | | | | | |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | $\overline{\overline{X}}$ | *SD of* $\overline{\overline{X}}$ | *t* | *df* [1] | *p* |
| Active Leisure | 8.22 | 1.72 | 6.16 | 1.12 | 2.703 | 8 | .027 |
| Nonactive Leisure | 9.30 | 1.06 | 6.23 | 1.08 | 6.393 | 9 | .000 |
| Snacking | 8.20 | 1.62 | 6.23 | 1.08 | 3.376 | 9 | .008 |
| Sleeping | 9.40 | 1.07 | 6.23 | 1.08 | 6.316 | 9 | .000 |
| Work/Studying | 4.89 | 3.59 | 6.31 | 1.12 | -1.158 | 8 | .280 |
| Household Duties | 3.89 | 3.10 | 6.29 | 1.13 | -2.471 | 8 | .039 |
| Transportation | 4.40 | 3.03 | 6.23 | 1.08 | -2.012 | 9 | .075 |
| Body Care | 5.10 | 3.07 | 6.23 | 1.08 | -1.458 | 9 | .179 |

*Note.* Statistical significance ($p \leq .002$) was determined using adjusted alpha levels according to Bonferroni's correction.

[1]Number of respondents varied for different items, so *df* reflect number of responding participants for each pair wise comparison.

$\overline{\overline{X}}$ = *grand mean.*

**Table F16**

*Statistical Results for Paired Comparisons of Mean and Grand Mean based on Ratings of Concentration of Daily Life Activities*

| Daily Life Activities | Concentration Statistics | | | | | | |
|---|---|---|---|---|---|---|---|
| | *M* | *SD* | $\overline{\overline{X}}$ | *SD of* $\overline{\overline{X}}$ | *t* | *df* [1] | *p* |
| Active Leisure | 4.44 | 1.33 | 5.66 | 1.23 | -1.969 | 8 | .084 |
| Nonactive Leisure | 1.90 | 2.73 | 5.86 | 1.32 | -5.923 | 9 | .000 |
| Snacking | 3.40 | 3.34 | 5.86 | 1.32 | -3.164 | 9 | .011 |
| Sleeping | 4.10 | 4.18 | 5.86 | 1.32 | -1.645 | 9 | .134 |
| Work/Studying | 6.67 | 3.32 | 5.97 | 1.35 | 0.552 | 8 | .596 |
| Household Duties | 3.78 | 2.44 | 6.12 | 1.10 | -3.754 | 8 | .006 |
| Transportation | 5.10 | 3.25 | 5.86 | 1.32 | -0.813 | 9 | .437 |
| Body Care | 5.10 | 2.69 | 5.86 | 1.32 | -1.056 | 9 | .319 |

*Note.* Statistical significance ($p \leq .002$) was determined using adjusted alpha levels according to Bonferroni's correction.

[1]Number of respondents varied for different items, so *df* reflect number of responding participants for each pair wise comparison.

$\overline{\overline{X}}$ = *grand mean.*

## Vita

Rachel Lynn Boxell was born in Marion, Indiana. She grew up in Naples, Florida and graduated from Gulf Coast High School in 2000. From there she went to the University of West Florida in Pensacola, Florida. Rachel took time off in the middle of her undergraduate career to thru-hike the Appalachian Trail. Returning to the University of West Florida in 2004, she completed her undergraduate education and received a Bachelor of Science Degree in Exercise Science in 2006. With a love for sport and a passion for education, Rachel chose to pursue graduate school.

In 2006, Rachel entered graduate school at the University of Tennessee, Knoxville. While completing her graduate degree, Rachel taught undergraduate classes, in 2006, in the university's Physical Education Activity Program. Her work as a graduate teaching assistant led to her receiving the 2007 A. W. Hobt Memorial Award for excellence in teaching. In 2007, Rachel received an assistantship with the University of Tennessee RecSports program as a Facilities Graduate Assistant. In 2009, Rachel will graduate with a Master of Science degree in Sport Studies with a concentration in Sport Psychology.