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DESCRIPTION OF THE PRACTICE HISTORIES AND KNOWLEDGE STRUCTURES OF HIGH SCHOOL BASEBALL PLAYERS

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DEDICATION

To my wife, Whitney: Words will never fully do justice to how much you mean to me. I could never have accomplished this without your unconditional love, support and friendship. You are the most incredible person I've ever met and I love living life with you. To my daughters, Allie and Mia, I want you both to know that you can do in life whatever you want to do. The world is in the palm of your hand – continue to be inquisitive, energetic, curious, and happy. These traits, among others, will take you a long way. I love you both and cannot wait to see what life brings your way.

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ABSTRACT

Early specialization (Ericsson, et al., 1993) and early diversification (Cote, 1999) are two highly debated approaches to the development of elite sport performance. More research is needed to determine the types of practice that aid in the development of elite sport performance. Further, studies describing the practice and competition histories of high school baseball players are needed to determine the role of early specialization and non-specialization in the development of baseball players between the ages of 14 and 18. Two studies were conducted. The purpose of the first study was to determine whether predictions from early specialization (deliberate practice, Ericsson, et al., 1993) or the early diversification (sampling a variety of sports, Cote, 1999) more accurately described the practice history of high school baseball players. Retrospective interviews (Cote, Ericsson & Law, 2005) were used to collect information related to participants' developmental histories. Participants (n=51) began at an early age (5) and were playing year round for multiple baseball teams by age 10. In addition, total accumulated hours of practice for these high school players were similar to the hours for a different sample of high school players (Cathey, 2010). After 10 years involvement (between the ages of 5 and 14), players had accumulated an average of 3,200 practice hours. Similar patterns of practice and early engagement maybe necessary to become a successful high school baseball player. Results supported a trend toward early specialization and accumulation of deliberate practice (Ericsson, et al., 1993).

The purpose of the second study was to describe the knowledge structures of high school players. Interviews on five baseball defensive situations were conducted with 25 high school baseball players. Player responses were transcribed and analyzed for knowledge content. Results indicated high school players have more accurate and advanced knowledge structures than younger players. The high school players in this study reported practicing more advanced tactics at early ages. Future research is needed to determine what types of interventions and practice activities can best facilitate tactical development in these age groups.

TABLE OF CONTENTS

LIST OF TABLES

List of Figures

CHAPTER 1

INTRODUCTION AND REVIEW OF LITERATURE

General Introduction

Hundreds of thousands of youth and adolescents participate in a wide variety of baseball programs. Many participants begin as early as age five and continue to participate in baseball once they reach high school. Developing the motor skills and knowledge required to produce skillful performance in baseball during this time period is influenced by both deliberate practice and deliberate play. More studies across childhood and adolescence are needed to describe changes occurring in motor skills and the knowledge base as a result of extended practice and play. Two constructs will be presented in this chapter. First, the influence of practice on reaching expert levels of performance will be discussed, followed by a brief introduction to the knowledge base. Chapter 1 culminates with the presentation and justification for two journal articles which will be written from the data collected during this project.

Expertise and Practice

In 1973 Simon and Chase reported grand chess masters to have accumulated an average of 10 years and 10,000 hours of experience leading to what has become known as the "10-year rule". Throughout the 1970's and 1980's the "10-year rule" was supported as the characteristic of expert performance in domains such as music, mathematics, tennis, swimming and long-distance running. However, it was not until 20 years later that the researchers attempted to describe the types of experiences necessary to

achieve expert levels of performance as "deliberate practice" (Ericsson, Krampe, & Tesch-Romer, 1993). Essentially, the theory of deliberate practice postulates that performance levels attained are directly related to the amount of accumulated practice. The goal of deliberate practice is to improve performance through highly structured, and not inherently enjoyable, activities requiring physical and mental effort. The deliberate practice theoretical framework includes two predictions or assumptions. First, a monotonic relationship exists between the accumulated amount of time spent in deliberate practice and the level of achievement attained by an individual. Simply stated, the more deliberate practice one engages in, the greater the performance level. Second, individual differences in performance at a given age are directly related to the amount of accumulated deliberate practice. Individual differences can be attributed to starting age and the amount of weekly practice. Due to the linear relationship between age and deliberate practice, the earlier the starting age, the more accumulated deliberate practice. Additionally, when beginning deliberate practice at the same age, the individual accumulating more weekly deliberate practice will achieve a higher level of performance (Ericsson, et al., 1993). This had led some people to believe that expert levels of performance are only attainable when participants specialize in a given domain at an early age.

In contrast to Ericsson et al.'s (1993) deliberate practice theory, Cote (1999), using in-depth qualitative interviews, presented the Developmental Model of Sport Participation (DMSP) to describe three phases of athlete development leading to an expert level of performance. Contrary to the deliberate practice theory which suggests early specialization, the DMSP includes a sampling phase where individuals voluntarily

participate in a variety of activities without specializing in one, a specializing phase where athletes reduce the number of activities engaged in to one or two, and an investment phase where athletes specialize in only one activity. In addition to participating in multiple activities early in development, the distinguishing factor between the DMSP and deliberate practice is the role of deliberate play (Cote, 1999). Cote, Baker, and Abernethy (2003) described deliberate play as "developmental physical activities that are intrinsically motivating, provide immediate gratification, and are specifically designed to maximize enjoyment (p. 186)." Whereas Ericsson, et al. (1993) suggested that individuals should engage in large amounts of deliberate practice early, the DMSP reflected the roles of deliberate play and deliberate practice in the three phases of development. Specifically, individuals should engage primarily in deliberate play activities during the sampling years, equal amounts of deliberate play and deliberate practice activities during the specialization years, and primarily deliberate practice activities in the investment years.

Knowledge Structures

Sport performance is a "a complex product of cognitive knowledge about the current situation and past events combined with a player's ability to produce the sport skill(s) required (Thomas, French & Humphries, 1986, p. 259)." This definition proposes two components related to sports performance: cognitive response selection and motor execution responses. The current study is concerned with the cognitive response selection component.

When considering cognitive response selection, expert performers have distinct advantages over their novice counterparts. Janelle and Hillman (2003) summarized these advantages:

> Expert sport performers in both self-paced and externally paced tasks develop a deeper, more intricate knowledge base by which to form representations of typical sport scenarios; they are more efficient and effective in recognizing and responding to structured game situations; they are more capable of matching appropriate strategies and tactics to game situations, which allows them to respond more effectively; they are more attuned to the richest informational sources provided in the visual scene, which enables them to make efficient and appropriate decisions; and their attentional and coordination capabilities appear to be less influenced by variations in affective states (p. 39).

The previous discussion of deliberate practice emphasized that experts accumulate more hours of practice compared to novices in the same domain. The aforementioned cognitive advantages held by experts may be viewed as a function of practice. The question then becomes what are experts learning during practice? Both cognitive and motor studies demonstrate cognitive and motor processes may change at different rates as a result of the focus of practice. Additionally, what changes may be related to the type or focus of practice. For example, French and Thomas (1987) found that performance on a basketball knowledge test improved while skills did not across a youth basketball season for 8-10 and 11-12 year old boys. Studies on youth baseball players' (ages 7-10) problem solving of game situations demonstrated very little improvement in knowledge of decision making cross-sectionally (French, Nevett, Spurgeon, Graham, Rink and

McPherson, 1996). In this study, authors' field notes collected while observing practice sessions revealed a lack of practice opportunities for players with runners on base. Alternatively, as the type of practices experienced by players changed with age, Nevett and French (1997) found 12-16 year old baseball players to have better developed knowledge structures and exhibit better decision making during games than younger players, especially in defensive situations involving bunts, steals, and critical run scenarios. The author's observations of practices and games suggested older players engaged in practice of defensive tactics more often than players below the age of 12. The changes in cognitive performance, specifically the decision making abilities of athletes, may be related to the type or focus of practice sessions.

Purpose

The primary purpose of this study is to examine how changes in practice across age impact the development of high school baseball players' knowledge structures. Using data collected through qualitative interviews, two research articles will be written. These studies are summarized next.

Study 1

Early specialization (Ericsson, et al., 1993) and the DMSP (Cote, 1999) are two highly debated approaches to the development of elite sport performance. Studies conducted on elite athletes have indicated that expert performers begin practice earlier and accumulate more total practice time than non-elite athletes. Other studies indicated that experts sampled a variety of sports during the sampling stage of development (Cote, 1999) and began specializing in one sport between 15 and 16 years old. Little research exploring the developmental activities of baseball players exists.

In their study of youth baseball players, French, Spurgeon, & Nevett (1995) found deliberate practice and deliberate play to have a significant impact on skill development. Highly skilled youth baseball players between the ages of 7 and 12 reported practicing baseball skills significantly more often than less skilled players. Some of the practice could be described as deliberate practice (practicing with supervision) and some could be described as deliberate play (unsupervised practice with friends). Highly skilled players exhibited superior performance in throwing for distance, throwing accuracy, batting, and catching than less skilled players at each age. Measures of throwing and fielding skills were correlated with total practice time. It seems that both deliberate practice and deliberate play significantly impact the development of baseball motor skills between the ages of 7 and 12.

Cathey (2011) has also shown that deliberate practice and deliberate play has a significant impact on the ability of minor league baseball pitchers to reach an expert level of performance. All participants (novices and experts) reported early engagement with baseball (beginning at age 5), as well as participating in an average of three sports between the ages of 5 and 16. Most novices began pitching between the ages of 7 and 12. Half of the experts reported beginning their pitching careers at young ages and half began pitching in high school. All of the experts either began pitching at young ages or played infield positions (short stop, third base) prior to initiation of pitching. Thus, all the experts began practice of forceful throwing at a young age. By age 18, experts (M=5,424) accumulated more hours of baseball practice compared to novices (3,839). Additionally, experts (1,638) accumulated more hours of pitching practice than novices (M=895). While the findings supported the importance of early engagement in baseball,

retrospective practice histories of minor league pitchers provide evidence for some of the predictions made by Cote, Baker, and Abernethy (2003). For example, baseball players sampled approximately three sports during the sampling years (5-12) and only specialized in baseball during adolescence.

More research is needed to determine the types of practice that aid in the development of elite sport performance. Further, studies describing the practice and competition histories of high school baseball players are needed to determine the role of early specialization and non-specialization in the development of baseball players between the ages of 14 and 18. Studying high school junior varsity and varsity baseball players may provide further insight into these unanswered questions. This study can provide a better understanding of early specialization in the development of expertise in baseball by using a younger sample representing a variety of defensive positions. Additionally, the use of current high school baseball players may provide a more accurate reflection of practice histories, based on data from retrospective interviews, because participants are being asked to remember events from a shorter time frame.

The first journal article will answer the question:

1.) Do predictions from the theory of deliberate practice (early specialization, Ericsson, et al., 1993) or the Developmental Model of Sport Participation (sampling a variety of sports, Cote, 1999) more accurately describe the practice history of junior varsity and varsity high school baseball players?

Also, article one will describe:

2.) the hours of practice accumulated in different types of practice (regular season, post season, off-season, individual) and in the skills (batting, fielding,

pitching) practiced during childhood and adolescence by high school junior varsity and varsity baseball players.

3.) the types of practices experienced by high school junior varsity and varsity baseball players.

4.) the types and number of competitive games played by high school junior varsity and varsity baseball players.

Study 2

Study 2 will contribute to the understanding of how knowledge structures change throughout development as a result of practice and game experience. French, et al. (1996) explored seven to 10 year old baseball players' knowledge representations of defensive situations during situation interviews. Findings indicated youth baseball players have poorly developed knowledge representations of a series of defensive situations. The poorly developed knowledge representations were attributed to immature skill development, restricting their knowledge of defensive tactics, and their practice and game experiences. While observing practice sessions, the authors noted that defensive situations with runners on base were rarely conducted.

Nevett and French (1997) extended this research as they studied the knowledge representations of youth and high school baseball short stops using a talk aloud protocol during live game play. Findings indicated high school short stops provided more mature responses to game situations when compared to the youth short stops. An important transition in player knowledge representations seemed to occur between the ages of 12 and 16. Thus, describing the changes in knowledge structures during this time frame and what practice experiences may facilitate or hinder the development of knowledge

structures would enhance our understanding of how changes in the underlying mechanisms occur. In addition little research has been conducted on the knowledge representations of high school baseball players at infield positions other than short stop and different ages (junior varsity and varsity). This study can provide insight into the changes that occur in the knowledge representations of high school baseball players by utilizing a sample that includes a wider variety of positions. Additionally, the use of two groups (junior varsity and varsity) will provide some sense of what is being learned by players across a two to four year span as a function of type of practice and game experience. The second journal article has two purposes:

1.) describe the knowledge structures of junior varsity and varsity baseball players.
2.) describe the practice histories of junior varsity and varsity players that could specifically influence knowledge structures related to response selection.

Review of Literature

The purpose of this review of literature is to provide the reader with more background literature on the importance of practice in the development of expertise. In the first section of the review, the work of Bloom (1985) is presented because Bloom's work provided a basis for the development of the theory of deliberate practice (Ericsson, et al, 1993) and the developmental sport model advocated by Cote (1999). The theory of deliberate practice (Ericsson et al, 1993) and the developmental sport model (Cote, 1999) are summarized. Following each theory, sport research using each theoretical approach is summarized.

The second section of the review provides the reader with a summary of theoretical frameworks for the knowledge base and cognitive processing that underlie response selection processes in sport (decision making or tactics). A number of cognitive processes involved in sport performance are identified. Models for defining the knowledge base in terms of knowledge content and structure are presented. Theoretical models for the collection, analysis, and interpretation of knowledge representations are outlined. At the end of this section, recent research findings related to developmental trends in sport knowledge representations are summarized.

Development of Expertise

Research studies conducted by Bloom (1985), Ericsson, et al. (1993), and Cote, et al., (2003) have been the guiding frameworks for the development of expertise in a given domain. Each of these models will be reviewed in this section.

Bloom-The development of talent

Bloom (1985) conducted extensive retrospective interviews with individuals in a variety of talent fields, including art, mathematics, music, swimming, tennis, and science. Retrospective interviews were also conducted with the parents and siblings of individuals. Interviews focused on the types of training performed, family support, and influence of teachers and coaches throughout the individual's development. Bloom identified three stages of development based on these interviews. The stages included play and romance (early years), precision and refinement (middle years) and individualization (later years). These stages will now be reviewed.

Play and Romance: The early years Early years of development began when the individual was introduced to the domain around the age of five. In the early years

practice was described as playful, fun, and filled with immediate rewards for small accomplishments. In Bloom's own words, learning was:

> ..enjoyable and enticing. They were pursued out of curiosity, for fun, with surprising rewards and continuous excitement or challenge. For relatively little effort the learner got more than might be expected. The effect of this first phase of learning seemed to be to get the learner involved, captivated, hooked, and to get the learner to need and want more information and expertise (Bloom, 1985, p. 413-414).

When individuals became hooked, they spent more time actively engaged in the domain leading them to becoming more skilled.

The role of parents Based on their own interests, parents, relatives or family friends initiated involvement in a domain for most of the individuals in Bloom's study. When individuals developed an interest in a given domain, parents or other family members acted as their first instructors by providing informal lessons. Parents supported their children by providing encouragement and resources. Examples of resources needed in the early years included financial support, materials, and transportation.

The role of the coach/teacher/mentor When observing their child's advancing interests, parents began looking for more advanced instructors in a given domain. Athletes and musicians in Bloom's study began lessons at approximately six or seven years old. Coaches or teachers were chosen with care. The primary criterion for selection was the "teacher's ability to work with children (Bloom, 1985, p. 452)." Coaches and teachers needed the ability to teach the fundamentals of the domain in an enjoyable way, rather than a harsh or demanding way. At this point, parents were most

concerned with finding someone who would take an interest in their child and had the right personality. The technical expertise of the teacher/coach was a secondary concern. The relationship between the individual and coach/teacher could be described as one of love.

During instructional sessions, parents remained involved in the development of their children by going to the lessons and listening to instructions given in the domain, and making sure that their children were prepared for each lesson. Understanding the importance of daily practice, parents monitored daily practices while reinforcing hard work and a "give your best" attitude. Additionally, parents bought books, magazines and other resources to advance their own knowledge of the field.

Precision and Refinement: The middle years The precision and refinement phase of development shifted the focus of practice to the refinement of specific skills and techniques necessary for success in the domain. Large amounts of time were committed to becoming more precise with the technical skills and vocabulary of the domain. Practice became more formalized and rational, rather than personal. The rules and logic of the field were presented in a disciplined and systematic way. Individuals developed a sense of competence from hard work and practice accomplishments. Additionally, public competitions became a source of motivation for learning and improvement.

Role of parents Due to the child advancing beyond the parent's level of expertise, participation in the child's practice sessions decreased compared to the early years. Parents supported their children by increasing the amount of money and time devoted to developing skill in the domain. Additional money might be needed to acquire better coaches, equipment, and to travel to competitions or training sessions. With the increases

in practice and added travel demands, parents sacrificed other activities they might normally pursue. Parents also provided emotional and motivational support to "remove obstacles, soothe failures, and help the child over humps (Bloom, 1985, p. 463)."

Role of coaches/teachers The transition from the play and romance phase was accompanied by a change in the coach/teacher. While the relationship between the coach/teacher in the play and romance phase was described as loving, the relationship between the two in this phase changed to one of respect. In the precision and refinement phase, the coach/teacher was described as more of a task master, capable of helping the individual refine his/her skills. It was expected that the coaches/teachers let it be known when they were dissatisfied with performances.

Individualization: The later years The individualization phase of development is characterized by individuals making the domain personal while making their own unique contributions to the field. At this point participants have gained a great deal of knowledge in the field. The issue becomes whether participants can "bring something of themselves to the experience (Bloom, 1985, p. 420)." Additionally, individuals become their own critics. They begin to identify and solve their domain-related problems on their own. Similar to the precision and refinement stage, large amounts of time were spent in practice. However, in the individualization phase, "practice began to take place as much in the head as in the hands (Bloom, 1985, p. 422)." Pianists, for example, were expected to practice between four and seven hours and think about or work at music for eight to 10 hours per day.

Role of the parents Similar to the transition between the first two stages, the transition to individualization observed changes in the role of the parents. Parents were

no longer aware of the practice demands on their children, but remained emotionally supportive while continuing to provide resources such as large sums of money for training, college, academies, etc. Parents became more reliant on their children's, and their coaches/teachers' opinions related to where they should be attending training sessions or college.

Role of the coach/teacher Since individuals have taken on the role of identifying and correcting their own errors, the role of the coach/teacher evolved. Rather than a task master, the teacher/coach became someone who could take the individual to the next level. These coaches were viewed as "slave drivers (Bloom, 1985, p. 421)" as they did not tolerate sloppiness or laziness. When coaches were disappointed, they quickly demonstrated that students had not met their standards.

Summary Bloom's description of the development of 120 individuals in various talent fields has provided a foundation for guidelines related to becoming successful in a specific domain. Three major themes developed from his work. First, learners progress through stages of learning that are not necessarily restricted by age. These stages must occur in order. That is play and romance must precede precision and refinement which must precede individualization. Second, parents and teachers/coaches play significant roles in the development of children. Third, developing skills in a domain requires commitment, sacrifice, and a large amount of practice. Findings from Bloom's (1985) work supplied the foundation for two additional developmental frameworks, deliberate practice (Ericsson, et al., 1993) and deliberate play (Cote, et al., 2003). The theory of deliberate practice will be presented next.

Theory of deliberate practice

In 1973, Simon and Chase reported no grand chess master had less than 10 years and 10,000 hours of experience in the field leading to what has been termed the "10-year rule". Studies conducted on music, mathematics, tennis, swimming and long-distance running throughout the 1970's and 1980's supported the idea of the "10-year rule" as the defining characteristic of expert performance in a given domain. Ericsson, Krampe, and Tesch-Romer (1993) constructed the deliberate practice framework to explain the type of experience necessary to achieve an expert level of performance. In their seminal study, Ericsson, et al. (1993) stated deliberate practice, rather than innate abilities were responsible for the attainment of expert performance. While Ericsson, et al. (1993) concede height and fiber type may be genetically pre-determined, height alone was the only factor that could not be altered through training. Even young prodigies and savants who accomplished a high level of performance in their given domains accumulated large amounts of practice and experience earlier in their careers compared to others in the same field (Ericsson, et al., 1993). Musicians recognizing a musical note by its pitch and the ability of expert typists to tap their fingers faster than others are the only known abilities with hereditary foundations. When ruling out heredity, one possible explanation for the achievement of expert performance is deliberate practice. Since its introduction to the field of expertise, deliberate practice has been explored in many different domains including music and sports. Implications of the theory of deliberate practice on the sports domain can be summarized by the following quote:

> If it is found that sport expertise is a consequence of deliberate practice, rather than innate ability, the implications for the selection of athletes at a young age are

enormous. Now, the emphasis would center on identifying those individuals who are believed to have the qualities such as motivation and commitment, necessary to put in the hours of practice to achieve expertise (Hodges & Starkes, 1996; p. 402).

Deliberate practice defined Deliberate practice is highly structured activity requiring physical and mental effort, and is not inherently enjoyable. The primary goal of deliberate practice is to improve performance (Ericsson, et al., 1993). Additionally, no immediate monetary rewards benefit those who engage in deliberate practice. "Individuals are motivated to practice because practice improves performance (Ericsson, et al., 1993, p. 368)."

The deliberate practice theoretical framework includes two predictions or assumptions. First, a monotonic relationship exists between the accumulated time spent in deliberate practice and the level of achievement attained by an individual. Simply stated, the more deliberate practice one engages in, the greater the performance level. Second, individual differences in performance at a given age are directly related to the accumulated deliberate practice. Individual differences can be attributed to starting age and the amount of weekly practice. Due to the linear relationship between age and deliberate practice, the earlier the starting age, the more accumulated deliberate practice. Additionally, when beginning deliberate practice at the same age, the individual accumulating more weekly deliberate practice will achieve a higher level of performance (Ericsson, et al., 1993).

Studies involving musicians (Ericsson, et al., 1993) and athletes (Hodges & Starkes, 1996; Helsen, Starkes & Hodges, 1998; DaMatta, 2004; Ward, Hodges, Starkes,

& Williams, 2007; Berry, Abernethy & Cote, 2008; Cathey, 2010; Smith, 2012; Ford & Williams, 2012) support the "10-year rule" by demonstrating experts have accumulated thousands of hours of deliberate practice over an extended time period (10 years or more). Furthermore, these studies indicate experts accumulate more practice than novices over this time period, supporting the assumptions made by the deliberate practice framework.

Constraints Deliberate practice is neither simple or short in duration. A minimum of 10 years of deliberate practice seems necessary to attain an expert level of performance. Additionally, throughout the time devoted to deliberate practice, Ericsson, et al. (1993) identified three constraints, resource, effort, and motivation that influence one's ability to achieve an expert level of performance. Individuals require access to resources such as supportive parents, training facilities, high-level coaching, money etc. Parents provide individuals with transportation, money for coaches, competitions, equipment, etc., and emotional support. Due to the intense nature of training sessions and the importance of acquiring expert coaching, parents may relocate their families to areas more convenient for training, coaching and competitions. Individuals without the necessary resources may never become experts (Ericsson, et al., 1993).

The second constraint is related to effort. Deliberate practice occurs over at least a 10-year time period and requires both physical and mental effort. Because of the intense nature of deliberate practice, there is a limit on the amount of deliberate practice one can engage in. Ericsson, et al. presented a review of studies demonstrating practices lasting longer than four hours a day produced no benefits (1993). Additionally, practices lasting longer than two hours resulted in reduced benefits. In sports, many skills require

maximum effort to be given multiple times in a given practice/game setting. If maximum effort cannot be produced, practice may become detrimental to overall performance. The amount of deliberate practice engaged in is regulated by an individual's ability to recover physically and mentally. Adaptation occurs slowly, allowing individuals to engage in increased amounts of deliberate practice. When recovery does not occur, individuals may become physically and/or mentally exhausted which can cause injury, overtraining, and burnout (Ericsson, et al., 1993).

A third constraint is motivation. A central tenant of the deliberate practice framework is that it is not inherently enjoyable. Deliberate practice requires individuals to be motivated when they are not receiving immediate rewards and when they may not be enjoying the practice time. If individuals are not motivated to practice, they are more likely to sacrifice practice time in favor of daily activities considered to be more enjoyable (Ericssson, et al., 1993).

Ways to study deliberate practice Deliberate practice has been studied using a variety of methods including retrospective interviews (Ericsson, et al, 1993; Baker, Cote, & Abernethy, 2003; Baker Cote, & Deakin, 2005; Berry, Abernethy, & Cote, 2008), surveys (Hodges & Starkes, 1996; Helsen, Starkes, & Hodges, 1998; Ford & Williams, 2012), rating scales (Ericsson, et al, 1993; Hodges & Starkes, 1998), diaries (Ericsson, et al., 1993; Helsen, et al., 1998), and systematic observation (Deakin, Starkes & Allard, 1998). The advantage of using retrospective interviews is that the researcher has access to elite athletes and their developmental histories. The disadvantage relates to long-term memory and the inability of individuals to provide a 100% accurate estimate of the

developmental activities completed and the amount of time spent engaged in deliberate practice.

Diaries have been used to gain access into the practice/daily activities of a recent week of expert performers (Ericsson, et al., 1993). The advantage is that individuals are recalling their daily activities over a one-week period rather than attempting to recall developmental activities over a time span of years. Additionally, days are broken into 15-minute increments, allowing for a very specific view of when individuals are engaging in deliberate practice. The primary disadvantage of using diaries is that sometimes individuals forget to fill them out – leading to an issue of recall.

Rating scales/surveys have been used to rate daily and domain-specific activities on their relevance to improved performance, concentration, effort, and enjoyment (Ericsson, et al., 1993). When using this method, a list of daily and domain-specific activities is compiled by coaches, elite teachers and expert performers. Individuals then rate the activities on concentration, effort, enjoyment and relevance to improved performance on a scale from zero to 10. When rating the enjoyment of an activity, Ericsson, et al. (1993) told musicians not to consider the potential benefits of practicing. The issue becomes what to consider a rating of zero and 10. For example, when rating the enjoyment of an activity, Cote, Ericsson, and Law (2005) explained that athletes should think about and describe an activity considered to be 100% fun at each age. This activity might be a birthday party, watching a movie, playing video games, etc. Once this activity has been identified as a point of reference, athletes then rate the enjoyment of practice activities on a scale from 0 – 10. When considering a reference point for

concentration and enjoyment, athletes are asked to think about their most intense years of training.

Microstructure studies (Deakin, et al., 1998) have used systematic observation to determine if individuals are actually practicing what they say they are practicing. The benefit is that actual practice activities are being observed through systematic observation. It begins to answer the question, what activities are being practiced the most and least? The disadvantage is that it is time consuming, expensive and requires access to practice sessions.

Music Studies To test their deliberate practice theory, Ericsson et al. (1993) conducted two studies on violinists and pianists. In the first study, thirty violinists from the Music Academy of West Berlin were divided equally into three groups: best violinists, good violinists, and music teachers. A fourth group, 10 middle-aged violinists, was included to provide additional information regarding the developmental histories of violinists.

Data collection procedures included a three-part interview. Session one focused on biographical information, estimates of the amount of practice time spent alone with the violin since beginning the activity, and ratings of everyday activities and musical activities based on relevance to improved performance, effort to complete the activity, and enjoyment. Session two posed questions related to practice and concentration. Additionally participants were asked to recall activities from the previous day. After this session, participants were asked to complete a seven-day diary divided into ninety-six 15-minute intervals representing each of the seven days. The third part of the interview

included time allotted for individuals to ask any questions they might have while providing a general debrief (Ericsson, et al., 1993).

Results from the biographical information revealed similar musical backgrounds for all participants. Violinists began practice at about eight years old, decided to become musicians at 15, and were taught by an average of four music teachers. By age 23, all participants had spent a minimum of 10 years practicing the violin (Ericsson, et al., 1993). Retrospective interviews of practice histories indicated the best young violinist group accumulated an average of 7,410 hours of practice by age 23. In comparison, the good violinists accumulated approximately 5,300 hours.

Information from the rating scales revealed seven of 12 musical categories to be more relevant to improved performance compared to the overall mean. Of the 30 violinists (best, good, teachers), 27 rated "practice alone" highest on relevance to improved performance. This finding can be explained using the constraints described previously. Musical activities ranked as highly relevant included practice alone, practice with others, taking lessons, solo performance, group performance, listening to music, and music theory. When considering the resource constraint, practice with others, taking lessons, solo and group performance cannot be directly controlled by individuals. Practice alone, listening to music and music theory can be controlled. Relative to everyday activities, sleep was the only activity rated higher than the grand mean in terms of improving performance. Similar to the controllable musical activities listed previously, sleep was also considered a controllable activity. Of the eight most relevant activities, six were rated as requiring more effort than the grand mean while two were rated as more enjoyable. Listening to music and sleep were rated as requiring a lower

amount of effort and listening to music and group performances were rated high on enjoyment (Ericsson, et al., 1993).

Seven-day diaries were used to determine the amount of time per week violinists were engaged in the activities rated most relevant. All participants were engaged in music-related activities approximately 50 hours per week. Best and good violinists (24.3 hours per week) spent more time engaged in practice alone compared to the music teachers (9.3 hours per week). Additionally, best and good violinists slept longer than the music teachers, providing evidence that the amount of deliberate practice violinists engaged in was constrained by effort and required recovery time (Ericsson, et al., 1993).

Study two involved 12 young expert pianists and 12 young amateurs (mean age of 24.3). Additionally, an age-matched sample with 12 older experts and 12 older amateurs (mean age 59.8) was used. Biographical information indicated experts had 14 years of playing experience, began receiving piano instruction at about 6 years of age and received approximately 19 years of formal instruction from an average of 4.7 teachers. In comparison, the amateur group had between 5 and 20 years of playing experience, began receiving instruction at about 10 years of age, and received an average of 9.9 years of instruction from three different teachers (Ericsson, et al., 1993).

Diary information demonstrated experts spent an average of 56.75 hours per week on music-related activities. Of these hours, 26.7 were devoted to practice alone. Amateurs spent 7.02 hours engaged in music-related activities and 1.88 hours/week in practice alone. Aligned with the results from Simon and Chase (1973) indicating that experts practice more than novices, retrospective estimates of accumulated practice time

indicated a significant difference in the practice hours of expert pianists (7,606) compared to the amateurs (1,606).

Summaries of studies of sport experts Deliberate practice activities and developmental histories of athletes have been studied in individual and team sports. Individual sport studies have included: wrestlers (Hodges & Starkes, 1996); martial artists (Hodge & Deakin, 1998); ultraendurance athletes (Baker, Cote, & Deakin, 2005); and figure skaters (Starkes, Deakin, Allard, Hodges, & Hayes, 1996; Deakin, Starkes, & Allard, 1998). Team sports studies have included: basketball (Baker, Cote & Abernethy, 2003); volleyball (DaMatta, 2004); Australian football (Berry, Abernethy, & Cote, 2008); soccer (Helsen, Starkes & Hodges, 1998; Ward, et al., 2007; Ford, Ward, Hodges & Williams, 2009; Ford & Williams, 2012); field hockey (Helsen, et al, 1998; Baker, et al., 2003) ice hockey (Soberlak & Cote, 2003); women's college basketball (Smith, 2012); and baseball (Cathey, 2010).

Data collection in sports has been conducted using methods previous discussed. Retrospective interviews and questionnaires have been used to determine biographical information and accumulated practice time. Rating scales have identified the most relevant sport-specific and everyday activities to the improvement of performance. Rating scales have also been used to highlight those activities requiring more and less effort and concentration as well as which ones are enjoyable. The use of seven-day diaries in some studies has provided information regarding the amount of time spent in the most recent weeks of practice. While used relatively little, systematic observation of actual practices provided a sense of what actually occurs in practice sessions.

Individual sports In the first study conducted on athletes, Hodges and Starkes (1996) studied 15 wrestlers on the Canadian National Team and nine wrestlers on the McMaster University Club wrestling team. All wrestlers began the sport at about 13 years old and began systematically practicing one year later. Retired wrestlers reported reaching peak performance at an average of 11.4 years into their careers. After 10 years of experience, the international wrestlers accumulated 5,881.9 hours of practice compared to 3,571.1 hours of practice for the club members. Three years in into their careers, international wrestlers were practicing 26.2 hours/week while club wrestlers were practicing 20.9 hours/week. Differences in the amount of hours spent engaged in all wrestling-related activities began to differ at about six years into their careers when international wrestlers were committing 38.7 hours per week compared to 28.4 hours/week for the club wrestlers. Another interesting finding related to the number of competitions engaged in by the two groups. While no main effects were reported, the international wrestlers were competing in 13.7 events compared to 8.5 for the club wrestlers. No significant differences were found between the groups for number of matches wrestled or clinics attended.

In contrast to Ericsson, et al. (1993) activities rated high for relevance and effort (mat work and working with a coach), were also rated higher than the grand mean for enjoyment (Hodges & Starkes, 1996). The finding that relevant activities were also considered enjoyable began a recurring theme in the study of athletes. Athletes tend to enjoy the most relevant deliberate practice activities. Additionally, an important finding from the study with wrestlers is the separation of concentration and effort. Specifically, working alone with a coach was rated high in concentration, but low in physical effort.

Similarly, running was rated as high in effort and low in concentration (Hodges & Starkes, 1996).

Hodge and Deakin (1998) studied two groups of martial artists at the Martial Arts Canada Program. The first group was comprised of first degree black belt students (mean age 18.4) with an average of 7 years of experience. Group two was comprised of novices (mean age 17.4) with just over one year average experience. Results indicated black belt martial artists devoted 27.6 hours/week to karate-related activities during their first year of participation, 41.4 hours/week during their third year and 58 hours/week during their fifth year. These results supported the monotonic relationship between time spent engaged in a field and the increase in practice time (Ericsson, et al., 1993).

Starkes et al., (1996) conducted research on the developmental histories of 20 members of the Canadian National Figure Skating Team. Figure skaters averaged 17.25 years old, began their careers at 5.2 years old, began receiving private lessons at about 7.68 years old and began skating year-round at approximately 9.95 years old. On average, figure skaters had been coached by 4.9 coaches. Expert skaters practiced alone an average of 7.8 hours/week two years in their careers, 14 hours/week at six years, and 23.67 hours/week at 12 years. When completing the rating scales, figure skaters considered lessons with coach, choreography and on-ice training to be highly relevant and more enjoyable than the grand mean. This contrasts Ericsson et al.'s (1993) claim that deliberate practice is not enjoyable and further supports the findings from Hodges and Starkes (1996) on wrestlers.

Deakin, Starkes, and Allard (1998) explored the relationship between relevant practice activities and skill in figure skating by observing the microstructure of on-ice

practice sessions. Participants included 24 skaters training for the Canadian National and Junior National teams divided into three groups (elite, competitive and test). Data collection included the systematic observation of on-ice activities, questionnaires and the completion of a seven-day diary. Similar to the results from the aforementioned study (Starkes, et al., 1996) activities rated as highly relevant to improved performance included practicing jumps and spins, program run-throughs, private choreography lessons and private lessons on jumps and spins (Deakin, et al., 1998). Systematic observation of the microstructure of practices included keeping detailed logs of jump attempts, spins, lessons, program run-throughs, and rest time. Results indicated the elite group spent 68% of practice time on jumps compared to 48% of time for the test group. Additionally, elite skaters rested 14% of practice time compared to 46% of time for the test group.

Baker, et al. (2005) examined the developmental activities using interviews of 28 ultra-endurance triathletes divided into the following three levels of performance: expert, middle of the pack and back of the pack. Experts averaged 31.3 years of age, had been competing in triathlons for 11 years, and averaged 6 Ironman distance races at the time data was collected. The back of the pack group averaged 33.8 years old, had been competing in triathlons for five years, and competed in an average of 2.6 Ironman distance races. Throughout their careers, experts accumulated 12,557.9 hours of training for triathlons compared to 6,195.8 for the middle of the pack group and 4,122.7 for the back of the pack group.

Team sports Ericsson et al. (1993) originally identified deliberate practice as practice alone. In their studies of musicians, practice alone was determined to be the differentiating factor between experts and non-experts. Individual sports summarized

above began to demonstrate differences in the sports arena and musical arena. Specifically, practice with others was also considered deliberate practice (Hodges & Starkes, 1996). Team sports present additional issues (Helsen, Starkes, & Hodges, 1998). First, practice is usually coach-determined. Because practice is coach-determined, athletes may have little input in how long practices may last or how many times they are held throughout the week. Second, there is the issue of whether individual and team practice should constitute deliberate practice. Helsen, et al. (1998) considered both individual and team practices to be deliberate practice. Finally, the underlying nature, history and type of team sports must be taken into account. For example, European soccer is traditional, highly organized, and provides opportunities for advancement. Alternatively, field hockey has less spectator support and no professional system in Europe. The amount of accumulated deliberate practice may differ as a result of the differences between the two sports.

Helsen, et al. (1998) used questionnaires, seven-day diaries, and rating scales to explore the practice histories of Belgian soccer and field hockey players. Soccer players began practice at approximately five years old and team practice at seven years old. International players reached their maximum number of deliberate practice hours per week (13.3 hours/week) at 15 years into their careers while provincial players reached their maximum (6.9 hours/week) at 6 years into their careers. Earlier in their careers, the amount of time committed to individual practice was significantly different. International players averaged 5.2 hours week of individual practice per week and provincial players averaged 3.1 hours of individual practice per week at six years into their careers. Between 12 and 15 years into their careers, the amount of time committed to individual

practice decreased from 3.6 hours/week to 1.8 hours/week for the international group. The decline in individual practice can be attributed to an increase in team practice. At 12 years into their careers, significant differences were found between the international (9.2 hours/week) and national groups (6.9 hours/week) related to amount of time devoted to team practice. The number of hours per week in team practice increased for only the international group. Specifically, international players committed 5.9 hours/week to team practice at 9 years, 9.2 hours/week at 12 years and 11.5 hours/week at 15 years into their careers. Differences in accumulated practice hours were observed at 10 years of experience. International players accumulated 4,587 hours of practice at this point compared to 3,306 for the provincial group. After 18 years, international players accumulated 9,332 hours and provincial players accumulated 5,079 hours of deliberate practice. Team practice accounted for approximately 64% of deliberate practice (Helsen, et al., 1998).

Field hockey players began the sport and team practice at 8 years old. International players reached their peak level of deliberate practice hours (19.1 hours/week) at 18 years into their careers. Provincial players were committing a maximum of 8.1 hours/week at 9 years involvement. Significant differences were found in team practice hours at 12 years involvement (international – 8.2 hours/week; provincial – 3.8 hours/week). After 18 years, accumulated hours of deliberate practice for international players was 10,237 compared to 6,048 for provincial players. Team practice accounted for approximately 53% of deliberate practice. Rating scales revealed soccer players considered games tactics and technical skills and running during team practice to be most relevant to improving performance. Team activities relevant to

improving performance in field hockey included games, exhibition games, tactical skills, technical skills and running. Similar to Ericsson, et al. (1993), soccer and field hockey players rated sleep high on relevance (Helsen, et al., 1998).

Soberlak and Cote (2003) studied the developmental activities of four junior hockey team members in the Canadian Hockey League between the ages of 6 and 20. Participants accumulated a total of 9,004 hours of involvement in ice-hockey, 3,072 hours of which were deliberate practice, 2,436 hours in organized competition, and 2,308 hours in other sports. The remaining 3,506 were devoted to deliberate play activities which will be discussed later in this review.

Da Matta (2004) conducted interviews with 10 members of the Brazilian Women's National volleyball team (experts) and 10 club/collegiate volleyball players (intermediates). Older experts typically began practice at age 11 and had accumulated a minimum of 10 years involvement in organized practice. In contrast, intermediates had between eight and ten years. In support of Ericsson et al.'s (1993) monotonic relationship, the amount of time volleyball players spent practicing increased with age. By age 15, older experts were practicing more weeks per year (about 44) compared to intermediate players (M=38.7) (Da Matta, 2004). Additionally, at age 15, older experts were practicing an average of 29.86 hours per week while the intermediate group practiced 17.62 hours per week. At 17 years of age, both expert groups accumulated more practice hours than the intermediate group. By age 20, older experts accumulated 10,199 hours of practice, younger experts accumulated 8,877 hours, and intermediates accumulated 5,568 hours. At 30 years of age, the older group had accumulated 25,018 hours of practice. An additional important finding from Da Matta's work related to

competition time per year. The amount of time spent in competition increased linearly with age in all groups. Results indicated there were group differences at each age for the amount of time spent in practice. Older experts competed more at each age level (Da Matta, 2004).

A series of studies have been conducted on the developmental activities of English soccer players (Ward, Hodges, Starkes, & Williams, 2007; Ford, Ward, Hodges, & Williams, 2009; Ford & Williams, 2012) leading to the early engagement hypothesis (Ford, et al., 2009). Ward, et al. (2007) used a cross-sectional design to study the development of under-18 years old soccer players in the English Football Association. Participants began soccer activities at the age of seven. After 11 years of involvement, elite soccer players accumulated 4,542 compared to 2,100 hours for the sub-elite. Using the same data set from the Ward, et al. (2007) study, (Ford, et al., 2009) created three groups (still-elite, ex-elite, recreational) to explore differences in the developmental activities of soccer players between the ages of six and 12. Results indicated the two elite groups spent on average 235 hours/year engaged in deliberate practice activities. When multiplying this number times six, 1,410 accumulated hours were devoted to practice. In comparison, the recreational group averaged 87 hours/year (522 total hours). Additionally, still-elite athletes engaged in 40 hours/year of competition. Finally, Ford and Williams (2012) studied the developmental activities of 16 professional and 16 non-professional soccer players. Non-professional players were those asked to leave youth soccer academies in England while professional players were given scholarships to become full-time athletes. All participants were 15 years old at the time of data collection. Results indicated that professional players (M=5.9 years old) were

significantly younger than non-professional players (M=6.8 years old) when beginning their careers. All players began soccer competition between the ages of seven and eight. Additionally, players started elite training programs between 10 and 11 years old. Professional players, after 10 years of involvement, accumulated 4,840 hours of deliberate practice. This may be compared to 3,518 hours for non-professionals. In summary, soccer professional soccer players began their careers early, between the ages of 5 and 6 and accumulated more hours of practice compared to non-professional players. The early engagement hypothesis (Ford, et al., 2009) has been proposed as a possible explanation for the advancement to professional status.

Cathey (2010) interviewed two groups of baseball pitchers ranging in age between 18 and 25. Group 1 (expert group) was comprised of 11 professional minor league baseball pitchers. Group 2 (non-expert group) was comprised of 10 high school baseball pitchers who had not pitched in college or professional baseball. All players began playing baseball between the ages of three and nine. Between the ages of five and 18, expert pitchers were engaged in baseball activities for 12 years and non-experts for 13 years. Experts accumulated 5,424 hours of baseball practice compared to 3,501 for the non-experts. Additionally, experts accumulated 1,638 hours of pitching practice while non-experts logged 895 hours.

Cote's Developmental Model of Sport Participation

Using Ericsson's framework, Cote (1999) conducted 15 in-depth interviews with individuals from four different families (four athletes, four siblings, four mothers, and three fathers). Information from the interviews led to the formation of three levels of developing sport expertise: sampling years, specializing years, investment years. The

three phases have been included in what is known as the Developmental Model of Sport Participation (DMSP) (Cote, et al., 2003). While similarities exist between Cote's work and Bloom's (1985) work, Cote (1999) describes two main differences between the constructs. First, the developmental model of sport expertise (Cote, 1999) is sport specific and based on the theoretical concepts of deliberate practice and deliberate play which distinguish the transition between the three phases of development. A definition for deliberate play as well as the role of deliberate practice and deliberate play in each phase of development will be further explored in subsequent sections of this review. Second, Cote's model specifically states that the time span covered by the phases of development begins at approximately six years old and ends at 18 years old (Cote, 1999). Bloom's (1985) phases cover the entire career of an individual.

Deliberate play defined Deliberate play, coined by Cote (1999), is similar to playing a game (Cote & Hay, 2002). Deliberate play:

> involves an implicit or explicit set of rules. Children or adults, however, often modify the rules of existing games. Ice hockey and basketball rules, for example, are regularly changed to suit the needs of children playing in the street or in youth sport leagues. Children typically modify the rules of the sport (as they perceive them) to find a point where it most resembles the sport and yet allows them to play it at their level. Thus, when sports are not working out, when they are perceived as boring and not enjoyable by children, the parameters of the sport could be changed and adjusted to better meet the children's needs and demands (Cote & Hay, 2002, p. _).

Cote, Baker and Abernethy (2007) go on to describe deliberate play as "developmental physical activities that are intrinsically motivating, provide immediate gratification, and are specifically designed to maximize enjoyment (p. 186)." Differences between deliberate play and deliberate practice exist in six dimensions: goal of the activity, perspective of individuals as they engage in the activities, how the activity is monitored, correcting poor performances, immediacy of gratification, and sources of enjoyment (Cote, et al., 2003). Differences in the dimensions are summarized in table 1.1.

Table 1.1

Dimensions of deliberate play and practice

Dimensions	**Deliberate play**	**Deliberate practice**
Goal	Fun	Improve performance
Perspective	Process-experimentation	Outcome (ends)
Monitored	Loosely monitored	Carefully monitored
Correction	No focus on immediate correction	Focus on immediate correction
Gratification	Immediate	Delayed
Sources of Enjoyment	Predominantly inherent	Extrinsic

(Adapted from Cote, Baker, & Abernethy, 2007)

Differences between the two theories were further developed by Cote, et al. (2007). Deliberate play was described as: done for its own sake, enjoyable, pretend quality, interest on the behavior, flexible, not requiring adult involvement, and occurring in various settings. In contrast, deliberate practice was described as: done to achieve a future goal, not the most enjoyable, carried out seriously, interest on outcome of the behavior, performed with an explicit set of rules, primarily requiring adult involvement, and occurring in specialized facilities. The amount of engaged time with an activity also differs when deliberately playing or practicing. For example, when playing two-on-two street basketball for one hour, individuals take fewer rest periods when compared to

participating in an organized practice session devoted to improving skill level in basketball (Cote, et al., 2007).

Cote's (1999) phases of development will now be described. The phases of the DMSP include the sampling years, specializing years and investment years.

Sampling Years The sampling years occur between the ages of six and 12 (Cote, 1999). Individuals are afforded opportunities to voluntarily sample a variety of activities without specializing in one activity (Cote & Hay, 2002). The main emphasis of the sampling years is to "experience fun and excitement through sport (Cote, 1999, p. 401; Cote, et al., 2003, p. 92)" as opposed to competing. Organized sporting activities during the sampling years provide immediate gratification, pleasurable, and involve intrinsic motivation (Cote & Hay, 2002).

Similar to Bloom's play and romance stage (1985), parents are initially responsible for their child's interest in sports (Cote, 1999). Parents provide their children with fun and enjoyable activities in order to better engage them and to encourage future involvement. Additionally, parents are supportive and encourage their children (Cote, 1999; Cote & Hay, 2002). Critical to the transition between phases of development is skill development and enjoyment (Cote & Hay, 2002).

Specializing Years Specialization occurs between the ages of 13 and 15 when the athlete reduces the number of activities engaged in to one or two (Cote, 1999). Criteria for narrowing the focus included positive experiences with the coach of the team, support from older siblings, and enjoyment of the sport (Cote & Hay, 2002). While fun and excitement remained central components of this phase, the athlete began to participate in activities designed to improve sport-specific skills.

Parents continued to encourage children while emphasizing achievement in school and time devoted to the sports chosen for specialization. Additionally, parents supported their children emotionally and by providing money for transportation, uniforms, equipment, etc. (Cote, 1999).

Investment Years Investment occurs between the ages of 16 and 18. The primary goal is achieving an elite level of performance in one activity (Cote, et al., 2003). Activities during this phase become more intense and less playful in nature.

Similar to the specializing years, parents are very interested in the individual's sport of choice and the athlete becomes the center of the family's schedule. Parents aid in fighting any setbacks, such as injuries, pressure, and fatigue that might hinder the athlete's progress (Cote, 1999).

Deliberate Play and Deliberate Practice in each stage The amount of deliberate practice and deliberate play in which an individual engages differs during the phases of development (Cote, 1999; Cote & Hay, 2002). Cote and Hay (2002) report an inverse relationship between the amount of deliberate play and deliberate practice across the phases of development. More specifically, the sampling years are comprised of large amounts of deliberate play and very little deliberate practice. The specializing years are comprised of equal amounts of deliberate play and deliberate practice, while the investment years shift to large amounts of deliberate practice and very little deliberate play. In support of this relationship, Soberlak and Cote (2003) found expert ice hockey players accumulated approximately 3,000 hours of deliberate practice and 3,500 hours of deliberate play in ice-hockey related activities. Of the 3,000 deliberate practice hours, 14.9% were completed during the sampling years compared to 72.1% in the investment

years. Of the 3,500 deliberate play hours, 74.7% were completed during the sampling years.

Ways to study Cote's Developmental Framework Cote, Ericsson, and Law (2005) provided retrospective interview methods for tracing the development of athletes. Interviews are comprised of three sections designed to answer two questions: "How does performance change over time?"; and "Can we predict differences in performances (Cote, et al., 2005, p. 5)." The three sections include: measures and description of current and past levels of performance; 2.) engagement in domain-related activities; and 3.) factors limiting the quality and quantity of training. These sections will be described below.

Measures and descriptions of current and past levels of performance are taken for each year the athlete is engaged in his main sport. Variables of interest include description and amount of time spent engaged in individual and/or team performance and sport specific milestones. Sport-specific milestones include win-loss records, selections to all-star or all-state teams, as well as other honors received. The goal of this portion of the interview is to determine at what ages individuals attained higher levels of performance (Cote, et al., 2005).

Engagement in domain-related activities refers to the types and amount of time spent each year the athlete engaged in activities related to the athlete's primary sport. Variables of interest include physical or mental training activities related to the sport, number of hours per week spent engaged in activity, number of months per year, enjoyment of each activity, physical effort and mental concentration. During the interview, athletes may be asked probing questions designed to elicit a list of organized training activities, self-initiated training activities, and individualized instruction. The

primary goal of the probing questions is to help athletes more accurately recall activities related to their primary sport. After generating the list of activities, athletes are then asked to estimate the quantity and quality of involvement in each activity for each year of involvement. In terms of quantity, the athlete is asked to estimate the number of months per year he engaged in domain-related activities. Additionally, the athlete is asked to estimate the amount of hours spent engaged in domain-related activities during an average week of participation. Once this information is obtained, the total amount of time per year can then be calculated. This section typically takes the form of charts used to elicit information about the variables listed (Cote, et al., 2005).

Factors limiting the quality and quantity of training include involvement in sporting activities other than the primary sport, height and weight, quality of training resources, and the athletes health/injury history. Athletes are asked to list all sport activities outside the primary sport of participation. The goal is to determine the impact of other sports on the primary sport. For example, there may be transfer effects related to strategies and tactics between multiple sports. As a result, engagement in other sports with similar strategies/tactics may positively impact the athlete's performance in the primary sport. Increases in height and weight have been linked to increases in sports performance. Determining the height and weight of athletes at each year of involvement may provide relevant information related to their performance at various age levels. Quality of training resources begins by identifying a training situation that is most desirable (100%). Once this training situation is identified, the athlete assesses his training resources for each age of participation. Health and injuries can significantly reduce the amount of time one is able to engage in practice or playful activities. For each

year of involvement, athletes are asked if they sustained an injury that reduced the amount of time they were able to engage in the activity. If they sustained an injury, they are then asked to estimate the amount of time they lost due to the injury (Cote, et al., 2005).

Summary of studies A series of studies have explored the amount of time athletes spend engaged in deliberate play activities. Studies have included ice hockey (Soberlak & Cote, 2003), netball, basketball, and field hockey (Baker, Cote, & Abernethy, 2003), Australian football (Berry, Abernethy, & Cote, 2008), and basketball, soccer, handball, and field hockey (Memmert, Baker, & Bertsch, 2010). These studies can be interpreted using Cote's DMSP and will be reviewed next.

Team sports Soberlak and Cote (2003) conducted interviews with four expert ice hockey players on the junior hockey team in the Canadian Hockey League. Players were 20 years old at the time of the interviews. The purpose of the study was to explore the developmental activities of the participants from the age of 6 to 20. Results indicated elite hockey players engaged in 3,072 hours of deliberate practice, 3,506 hours of deliberate play, and 2,436 hours of organized competition in hockey. This is a total of 8,924 accumulated hours of time spent engaged in hockey-related activities. Of the 3,072 practice hours, 459 hours (14.9%) were completed during the sampling years compared to 2,215 (72.1%) during the investment years. Of the 3,506 hours of play, 2,618 hours (74.7%) were completed during the sampling years. The breakdown of deliberate play and practice hours supports the DMSP framework regarding the amount of time spent in play and practice during development. Results also indicated hockey players committed 2,308 hours to other sports between the ages of 6 and 20. Of the 2,308 hours devoted to

others sports, 1,149 were completed during the sampling years. Again, this supports Cote's model.

Baker, et al. (2003) researched the developmental histories of 15 expert decision-makers from Australia's national women's netball team (n=3), national men's basketball team (n=4), national men's field hockey team (n=4) and national men's field hockey (n=4) teams. The study also included a sample of 13 non-expert decision-makers from the same teams. While they were still considered to be experts in their respective sports, they were considered to be non-expert decision-makers. Expert decision-makers had a mean age of 27.6 years. The number of years of involvement ranged from an average of 11 (basketball players) to 13.8 (field hockey players). The average number of years of involvement for all players was 12.9. Hours committed to practice ranged from 2,260 (netball players) on the low end to 5,908 (basketball players) on the high end. The average number of practice hours for all players was 3,939. The number of other sport activities engaged in varied by sport. Basketball players engaged in an average of 4.8 other sport activities compared to almost 12 for the netball players. The average number of other sport activities for all players was 8.6.

Berry, et al., (2008) studied the contribution of structured and deliberate play activities on expert Australian Football players' perceptual and decision-making skills. Using the interview protocol established by Cote et al., (2005), the developmental activities of 17 expert decision-makers and 15 less skilled decision-makers were examined (Berry, et al., 2008). Both groups of players began Australian football around eight years old. Experts and the less skilled athletes reported participating in an average of 4.41 and 3.73 structured activities respectively. At the time participants entered the

Australian Football League (AFL), expert decision makers accumulated 4,185 hours of structured activity compared to 3,223 for the less-skilled. Similar amounts of time were devoted to Australian-football-specific training by experts (M=2,510 hours) and the less-skilled M=(2,025 hours). Experts and the less-skilled averaged 4.18 and 3.53 deliberate play activities respectively. Before entering the AFL, no significant differences were found between the accumulated hours of deliberate play for the experts (M=2,210) and the less-skilled (M=1,124). A very small percentage of time devoted to deliberate play specifically related to Australian football was reported by both groups. Experts committed 449 hours to Australian-football-specific deliberate play activities compared to a mean of 135 hours for the less-skilled athletes. 35% of the experts ranked Australian football deliberate play activities as number four out of five possible activities. Similarly 20% of the less-skilled group ranked Australian-football-specific deliberate play fifth. The most popular deliberate play activity for both groups was basketball (Berry, et al., 2008).

Unique to Berry, et al.'s (2008) study was the examination of the types of structured and deliberate play activities. Categories of activities were identified and included invasion games, net/wall, field/run-score, target, and other sports. The mean number of invasion games played during development was significantly different for the experts (3.59) and less-skilled (2.53). Both groups engaged in more hours of practice involving invasion games. The expert group (M=3,279 hours) committed more time to practicing invasion game activities compared to the less-skilled group (M=2,287). Experts (M=1,039 hours) accumulated more hours of deliberate play within the invasion games classification compared to less-skilled athletes (M=328 hours). When combining

all structured and deliberate play activities, experts averaged 4,319 hours while the less-skilled averaged 2,615 hours. This was statistically significant. Differences in time committed to invasion activities appeared at age 12, when experts were averaging 200 hours more than the less-skilled athletes. No differences were found at ages six or 18. To summarize, discriminating factors between the expert decision makers and less-skilled decision makers included the amount of time devoted to all structured activities before beginning participation in the AFL and the amount of time spent in invasion games-related deliberate play especially in the sampling years. The authors also concluded that while Australian-football-specific activities were important to the development of perceptual and decision-making expertise, these activities were not the only factor responsible for differentiating experts from the less-skilled.

Memmert, et al., (2010) used questionnaires based on Cote, et al.'s (2005) interview guide to examine the impact of practice histories on the development of creative behavior in team ball sports. Creativity was described as the ability to produce original, unexpected and useful work. Participants included 72 athletes (mean age=23.2) on the following German national teams: basketball (n=18), soccer (n=18), handball (n=18), and field hockey (n=18). Players were considered to be either the most creative offensive players or least creative defensive players. When comparing the participants considered expert and non-expert in terms of creativity, significance was only found for the amount of time spent in deliberate play activities. Expert creative players averaged 2,857 hours of play compared to 1,954 for non-experts. Table 1 displays the age training was initiated, years of involvement, number of practice and play activities for each sport. Age of initiation into sports ranged from five years old (soccer) to 10 years old

(basketball). Hockey and handball players began around the age of six. As a result of earlier beginning ages, soccer players averaged 19 years of involvement and hockey and handball players averaged approximately 18. Basketball players averaged 11 years of involvement. Total hours invested in their main sports ranged from an average of 8,818 for soccer players to 3,412 for basketball players. Except for hockey players, athletes in the other three sports committed more time to practice than play. Table 1.2 also displays the breakdown of play to practice in the early years of sport involvement (< 14 years old).

Table 1.2

Participants' hours and activities (Memmert et al., 2010)

	Sport			
	Soccer	B-Ball	Hockey	H-Ball
Beginning Age	5.17 (1.1)	10.06 (2.92)	6.06 (2.56)	6.56 (2.16)
Years Involved	19.00 (4.09)	11.00 (2.79)	18.56 (3.13)	18.19 (3.46)
# Hours Involved	8818.00 (2728.89)	3412.83 (1596.46)	5654.00 (3029.82)	7063.65 (3130.24)
Training activities (play)	3575.00 (2358.49)	972.40 (487.40)	2638.39 (1403.60)	2338.27 (1311.60)
Training activities (practice)	4841.44 (2355.58)	2500.80 (1750.17)	2345.94 (2646.60)	3513.73 (2220.51)
Play activities (<14)	1423.67 (1101.34)	416.15 (267.71)	1498.33 (1076.43)	888.93 (808.69)
Practice activities (<14)	1212.11 (631.59)	732.69 (741.57)	805.50 (541.62)	942.13 (434.76)

Summary Cote's DMSP has provided a useful alternative model to investigate the developmental activities of athletes. Compared to the deliberate practice framework, the stages of development representing in the DMSP (sampling, specialization, investment) allow for a more specific description of the developmental activities undertaken by athletes. The sampling years are comprised primarily of deliberate play activities with very little deliberate practice. Additionally, engagement in multiple

activities is highly encouraged during this stage. The specialization years observe equal amounts of deliberate practice and deliberate play as athletes begin to narrow their foci to one or two sports. Deliberately practicing one sport becomes the primary focus of the investment years, while the amount of deliberate play drops significantly. In summary, as athletes increase in age, the amount of deliberate practice increases while the amount of deliberate play decreases. As a result of the increase in deliberate practice, individuals experience motor and cognitive changes. The primary focus of this review is on the cognitive changes that occur as a result of deliberate practice. These changes will be discussed next.

Characteristics of Experts

Sport performance has been defined as "a complex product of cognitive knowledge about the current situation and past events combined with a player's ability to produce the sport skill(s) required (Thomas, French & Humphries, 1986, p. 259)." Using this definition, sport performance entails two components: cognitive response selection and motor execution components. Studies conducted on the cognitive and motor aspects of performance reveal experts to have several distinguishing characteristics. In the cognitive domain, Glaser and Chi (1988) summarized seven findings distinguishing experts from non-experts. Characteristics included: 1.) experts excel in their own domains; 2.) experts perceive large meaningful patterns in their domain; 3.) experts are faster than novices at performing skills and solving problems – both completed with fewer errors; 4.) experts have stronger short and long-term memories; 5.) experts represent problems in their domain deeper than novices; 6.) experts spend more time qualitatively analyzing problems; and 7.) experts have stronger self-monitoring skills.

Based on their review of the motor domain, Abernethy, Burgess-Limerick and Parks (1994) suggested experts:

> a.) were faster and more accurate in recognizing patterns; b.) have superior knowledge of both factual and procedural matters; c.) possess knowledge organized in a deeper, more structured form; d.) have superior knowledge of situational probabilities; e.) be better able to plan their own actions in advance; f) be superior in anticipating the actions of an opponent; g.) be superior perceivers of essential kinematic information; h.) perform in a less effortful, more automatic fashion; i.) produce movement patterns of greater consistency and adaptability; and j.) possess superior self-monitoring skills (p. 186 – 187).

Almost 10 years later, Janelle and Hillman (2003) summarized the following advantages experts have over non-experts in sports:

> Expert sport performers in both self-paced and externally paced tasks develop a deeper, more intricate knowledge base by which to form representations of typical sport scenarios; they are more efficient and effective in recognizing and responding to structured game situations; they are more capable of matching appropriate strategies and tactics to game situations, which allows them to respond more effectively; they are more attuned to the richest informational sources provided in the visual scene, which enables them to make efficient and appropriate decisions; and their attentional and coordination capabilities appear to be less influenced by variations in affective states (p. 39).

The previous discussion of deliberate practice emphasized that experts accumulate more hours of practice compared to the novices in the same domain. The aforementioned cognitive advantages held by experts may be viewed as a function of practice. The question then becomes what are experts learning during practice? Both cognitive and motor studies demonstrate cognitive and motor processes may change at different rates as a result of the focus of practice. Additionally, what changes is a result of the type or focus of practice. For example, French and Thomas (1987) found that performance on a basketball knowledge test and decision making during games improved across the season whereas basketball motor skills did not improve across a youth basketball season for 8-10 and 11-12 year old boys. Studies on youth baseball players (ages 7-12) have demonstrated that baseball motor skills did improve across ages 7 to 10, however, knowledge of decision making improved very little across age (French, Nevett, Spurgeon, Graham, Rink and McPherson, 1996). In this study, authors' field notes collected while observing practice sessions revealed a lack of practice opportunities for players with runners on base. Alternatively, as the type of practices experienced by players changed with age, Nevett and French (1997) found 12-16 year old baseball players made better decisions regarding defensive situations involving bunts, steals, critical run situations, etc. The changes in cognitive performance, specifically the decision making abilities of athletes, can, in some cases, be attributed to the type or focus of practice sessions. The underlying mechanisms of decision making will be discussed next.

Underlying Mechanisms Involved in Decision Making

Considering an information processing viewpoint, there are multiple cognitive/perceptual processes that underlie decision making in sports. Tenenbaum (2003) depicted a model of some of the perceptual/cognitive processes involved in sport decision making. Tenebaum's model is shown in figure 1.1.

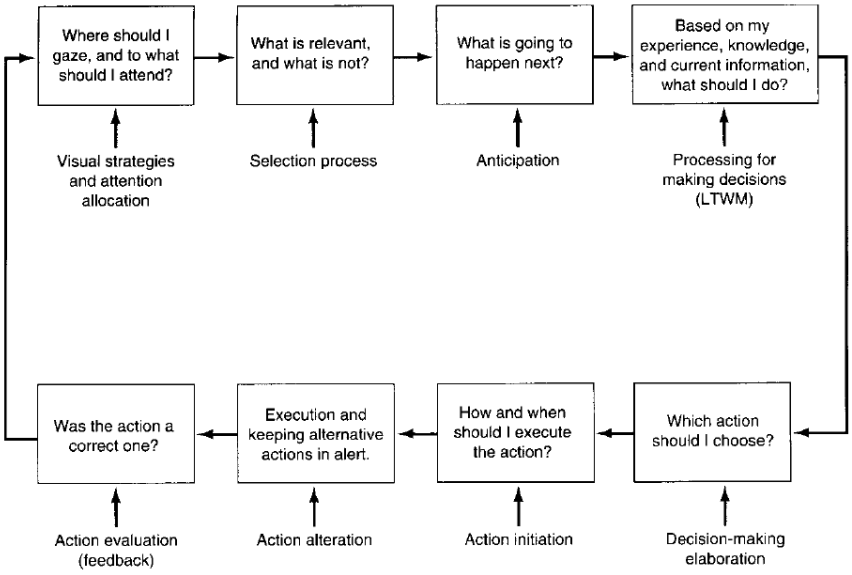

Figure 1.1 *Tenenbaum's (2003) model of decision-making types and their corresponding cognitive components*

The perceptual/cognitive processes identified include: visual search strategies, selection of relevant and irrelevant information, anticipation of events, activation and integration of important information into working memory and retrieval from long term memory, monitoring and updating response selections, and evaluating the effectiveness of response selections. The diagram suggests that these processes proceed in a linear fashion with visual search and selection processes occurring prior to involvement of working and long term memory. This is misleading. Most studies of expertise attribute superior performance of experts in all of these perceptual/cognitive processes to the underlying content and structure of information in long term memory. Therefore, the content and

structure of information stored in long term memory (sport concepts, visual cues and patterns) drives the visual search strategies, selection of relevant cues, anticipation, and response selection.

A variety of methodologies have been employed to study components of Tenenbaum's model. Laboratory studies using visual temporal and event occlusion paradigms, reaction time to simulated game situations, and eye movement recordings have shown that experts use more advanced visual search strategies and visual cues than novices (Tenenbaum, 2003). Experts also make more accurate and faster decisions than novices and can more accurately predict game actions in advance (Janelle & Hillman, 2003). Other studies have utilized verbal reports, in the form of situation interviews (McPherson, 1999b, French, Spurgeon, Nevett, et al, 1996), verbal reports during competition (McPherson & Thomas, 1989, McPherson 1999a, 2000), and talk aloud protocols during competition (Nevett & French, 1997), to determine the content and structure of the knowledge base (short and long-term memory processes) that underlie many of the components of this model. Defining the knowledge base becomes important at this point and will be discussed next.

Defining the Knowledge Base

The term knowledge base in cognitive psychology most often refers to the interactions between working and long term memory. Knowledge stored in long term memory must be retrieved or activated into working memory for use during performance on a variety of tasks. Knowledge content is retrieved or activated into working memory (brought into and out of working memory) from long term memory during problem

solving or task performance. Thus, the term "the knowledge base" involves interactions between working and long term memory.

The content and structure of information stored in long term memory has often been modeled as propositional networks or node link networks. Nodes represent concepts, links represent associations between or among concepts, and features are words that further define the concepts. In these networks, knowing more consists of possessing more concepts, more detailed features associated with each concept, and more links or associations between and among the concepts. McPherson (McPherson, 2000, McPherson & Thomas, 1989) has modeled sport specific knowledge in this type of propositional network as condition, action, goal concepts and linkages between these concepts. French and McPherson (2004) provide definitions of sport conditions, actions, and goals. Condition concepts are units of information that specify when or under what conditions to apply an action. Conditions may be explicit cues available in the environment (runners on base) or implicit cues available through tactical analysis and or retrieval from long term memory (opponent strength, weakness or tendency). Action concepts refer to response selections that may be chosen in game situations. Examples in defensive baseball would include throws to a given base, tags of a runner, position moves to field a ball or back up a throw. Goal concepts refer to words or phrases that specify the purpose of actions. Examples in defensive baseball would include to get an out, to get the lead runner, to prevent a run from scoring, to prevent a runner from advancing.

In a series of studies to elicit knowledge structures in tennis players, McPherson (1999a, 1999b, 2000; McPherson & Thomas, 1989) has shown that adult expert tennis players possess many more condition, action, and goal concepts than younger experts,

adult novices, and child novices. In addition, as the level of expertise increases, the structure of the knowledge accessed during competition tends to be condition/action driven with game conditions linked to specific and detailed actions. Younger and or less skilled players tend to access knowledge representations that are more goal oriented (to get it over, to hit it deep, etc.) without accessing specific condition action linkages that would indicate more advanced tactics (i.e. since she is at the net (condition/player location), use a topspin backhand down the line (action/where and how to hit the ball). Thus, sport knowledge structures can be modeled as propositional networks of condition, action, and goal concepts that are specific to a given sport.

Further studies have shown that the knowledge base for sport is comprised of more knowledge structures and processes than propositional networks. French and McPherson (2004) define the knowledge base for sport:

> to include all the traditional propositional networks of declarative knowledge (both tactical and skill related) and procedures for response selection and execution. In addition, we believe the knowledge base also includes other sport-specific memory adaptations and structures such as action-plan profiles, current-event profiles, game-situation prototypes, scripts for competition, and sport-specific strategies that are stored in and accessible from long-term memory (p. 408).

Studies in tennis (McPherson, 2000) and baseball (Nevett & French, 1997) show that older experts possess larger chunks of condition-action game sequences or larger action plan profiles. Knowledge representations of older experts also contain evidence of memory structures to gather information about the opponent during the competition

(current event profiles) that is used to plan future tactics, diagnose opponent strengths, weaknesses, and tendencies. These memory structures are created in a type of working long term memory (Ericsson & Kintsch, 1995) during the course of competition and integrated with action plan profiles to guide response selection and tactics during the competition. In these studies, current event profiles were only found in adult tennis experts (no tennis studies in adolescence) and in 16 year old short stops in baseball. Tennis and baseball players younger than 12-years-old did not exhibit evidence of current event profiles. Older baseball experts (age 16) also exhibit sport specific strategies (i.e. monitoring game conditions, rehearsal of plans, updating plans) during competition. Younger experts (age 8 and 10) either did not plan in advance what to do if the ball was hit to them on defense or used an immature rehearsal - repeated one plan over and over. By age 16, expert players could access multiple plans for the game situation, rehearse more than one plan, and update or modify that plan based on a change in game conditions (foul ball, ball-strike count, lead of a base runner).

Theories of Knowledge Acquisition

Two theories have been instrumental in providing a framework for how changes in the content and structure of knowledge occur with learning. Changes in the structure of the knowledge base have been modeled by Anderson's (1982) ACT theory and Rummelhart and Norman's (1978) Associative Structural Network (ASN) theory. Both of these theories are grounded in information processing and provide a foundation for discussing the changes taking place in an athlete's knowledge base as a result of practice.

Anderson (1982) suggested skill acquisition illustrates how one progresses from an interpretive form of declarative knowledge (i.e. propositional network of facts) to a

fast procedural form of knowledge (i.e., production system). Production systems may be referred to as generalized stimulus-response pairs or if-then links. When condition, action, goal concepts are used repeatedly and result in successful performance, gradually the linkages between these concepts become stronger. Anderson suggests that task specific productions (condition-action links) will only be formed when the production results in successful performance and is repeated many times. The advantage of task specific productions is a reduction in the demands of working memory and an increase in processing speed. French and McPherson (2004) suggested that changes in tactical sport knowledge can be described using propositional networks and productions systems. For example, if these game conditions exist (runner at third base; no outs; bottom of the 7th inning with the score tied; ball hit to the third baseman) then execute these actions (third baseman fields the ball, looks the runner at third base back to third base, and then throws to first base) to achieve the goal (preventing the game-winning run from scoring while recording the first out of the inning).

Rumelhart and Norman believed the schemata to be the "primary meaning and processing unit of the human information processing system (1978, p. 41)." Schemata were referred to as "active, interrelated knowledge structures, actively engaged in the comprehension of arriving information, guiding the execution of processing operations (p. 41)." Schemata contain variables and constants. Variables represent general categories of concepts, such as the location of the runners on base, the ball-strike count, number of outs, the inning, etc., that can be substituted to allow for the use of schemata in a specific situation. Constants, referred to as specific values or concepts, can be exchanged for variables associated with a general schema. For example, runners at first

and third may take the place of the variable associated with base runners and their locations. Similarly, one out (constant) may be substituted for number of outs (variable). Accordingly, schemata could be viewed as representations of the prototypes of concepts.

Based on the assumption that information is represented in memory as an interrelated network of schema, Rumelhart and Norman's (1978) ASN theory proposes three types of learning: accretion, tuning, and restructuring. Accretion refers to the accumulation of new information or simply adding items to long-term memory. Tuning increases the specificity of schema by modifying constant and variable terms. Restructuring refers to the reorganization of concepts and information stored in long-term memory.

The ASN theory may be used as an underlying framework for the development of current event profiles, defined as "structures used to keep active relevant information with potential past, current, and possible future events (French & McPherson, 2004, p. 418)." Furthermore, "current event profiles consist of tactical scripts that guide the constant building and modifying of pertinent concepts to monitor during the competitive event (French & McPherson, 2004, p. 418)." In baseball, a current event profile may consist of previous knowledge a defensive player has of hitters on an opposing team (i.e. their batting averages, whether they like to steal, hit and run, etc.), the pitcher on the mound for his own team (i.e. the types of pitches the pitcher likes to throw, his history against the opposing team, etc.), and the at-bats of hitters against the pitcher in the current game. For example, the third baseman may realize that the current hitter is the second hitter in the line-up, has little power, and has already successfully executed one sacrifice bunt down the third base-line with a runner on first and no outs. The third baseman may

also be knowledgeable of the fact that the pitcher on the mound does not move very well and struggles to cover his position in the event of a bunt. The current situation is a runner on first with no outs. Based on current event profile formed, the fielder may anticipate the hitter attempting another sacrifice bunt. Accessing this information should allow the third baseman to realize he needs to move closer to the batter in order to field the bunt quickly enough to have a chance at getting the lead runner at second base. If the ball is not bunted hard enough or there is a miscue of any kind, the third baseman should know to immediately throw to first base to record an out.

Studying Changes in Knowledge Structures

French and McPherson (2003) explain techniques associated with using verbal reports to elicit the thoughts of individuals as they solve static problems (situation interviews) and thought processes used during competition. Verbal reports, grounded in cognitive psychology, are commonly used as a way to report the content and cognitive processes associated with solving problems. Verbal reports are overt behaviors which must be interpreted through a theoretical framework of how verbal responses are produced. Ericsson and Simon (1993) provide the most useful model for collecting and interpreting verbal reports. Their model distinguishes between processing activities that are verbalizable and others that are not. Specifically, only information accessed to the level of working memory may be verbalized by individuals. The content verbalized is a sequence of thoughts activated into working memory during problem solving. Other processes (some perceptual and visual processing) are not directly verbalizable and require information to be translated into a verbal code. The output of the process (visual search, cue selected, or recognized) may then be verbalized. For example, if a short stop

states that a runner occupies first base, it can be inferred that he conducted a visual search of the playing field first and then translated that search into a verbal code.

Levels of Verbalization

Ericsson and Simon described three levels of verbalization. The first level is the vocalization of covert articulatory or oral encodings which excludes the need for intermediate processes requiring individuals to exert special effort to communicate. Level two involves the description or explication of the thought content. Explicating information is simply labeling information that already exists in working memory – no new information is brought into working memory at this time. While explicating information takes more time than simply vocalizing articulatory or oral encodings (level 1 verbalization), Ericsson and Simon hypothesized level two "does not change the structure of the process for performing the main task (1993, p. 79)." In contrast to level two, level three requires individuals to explain their thought processes. Rather than simply recoding information in working memory, the explanation of thought processes requires associating information in working memory to thoughts and information attended to previously. According to Ericsson and Simon (1993) "requiring a subject to explain his thoughts may direct his attention to his procedures, thus changing the structure of the thought processes (p. 80)." Because the instructions to verbalize do not interfere with the subject's thought processes, Ericsson and Simon support the use of level 1 and level 2 verbalizations which allow for an accurate production of the normally occurring thought processes. However, due to the identified problems with changing the subject's thought processes, the use of level three verbalizations were not supported.

Methods for Collecting Verbal Reports

Ericsson and Simon (1993) identified two methods of collecting verbal reports which should be considered direct verbalizations of cognitive processes: concurrent verbalization and retrospective recall. Concurrent verbalization refers to the vocalization of thoughts by individuals as they perform the primary task. The additional task of vocalizing thoughts while performing the primary task typically requires the researcher to simply instruct individuals to "think aloud". Individuals should not be asked to describe or explain what they are doing. This engages thoughts about previous tasks/experiences and relates to level three verbalization described previously. Simple instructions in the form of a question such as "what are you thinking" or prompts such as "keep talking" should allow individuals to accurately verbalize their thoughts. Ericsson and Simon (1993) "claim that cognitive processes are not modified by these verbal reports, and that task-directed cognitive processes determine what information is heeded and verbalized (p. 16)." It is important to realize that "why" a thought process was verbalized cannot be answered or inferred from the use of concurrent verbal reports.

The second method described was retrospective verbal reports. Ericsson and Simon assumed that "cognitive processes leave in long term memory a subset of the originally heeded information in the form of a retrievable trace of connected episodic memory (1993, p. 149). The use of retrospective verbal reports "involves retrieval of these episodic memories and verbalization of their content (1993, p. 149)." Thought processes verbalized during perceptual motor performances may interfere with the perceptual or motor performance. In these cases, retrospective interviews immediately after performance are the preferred method.

Talk aloud protocols have been used to examine sport experts' thoughts while solving static game problems (McPherson, 1999b, 2000; French, Nevett, et al. 1996) and during actual baseball games (Nevett & French, 1997). Retrospective interviews have been used to study thought processes during competition in tennis (McPherson, 1999a, McPherson & Thomas, 1989) and badminton (French, Werner, et al 1996). Players were asked what they were thinking during the previous point. These studies will be discussed in the section.

Studies Utilizing Verbal Reports

When individuals are asked to solve static sport problems (i.e. report thoughts during performance using either retrospective recall or talk aloud), the individual only accesses a portion of the entire knowledge base. Thus, it is important to sample a variety of game situations so that the individual accesses a larger portion of the knowledge that is stored in long term memory. In specific game situations, the expert individuals will initially access the portion of the knowledge base that relates specifically to the game problem at hand. French and McPherson (1999) refer to the "process of accessing a portion of the entire knowledge base to perform a specific task as representation of the problem or problem representation (p. 179-180)." They go on to explain two important reasons for this conceptualization of problem representations. First, only a small amount of the person's knowledge base can be understood as they complete a specific sport task. This supports the use of multiple sport performance situations to better understand an individual's knowledge base. Second, novices may tend to access part of the knowledge base that is not the most critical to performing a specific performance task. Said another way, novices may be able to access a great amount of sport knowledge, but it is not the

most critical or relevant knowledge necessary to perform the specific task. Each of the studies reported next have elicited knowledge structures and thought processes of participants using a variety of game situations (situation interviews) or have selected sample of thought from actual game performance from specific game situations. McPherson and colleagues (McPherson, 1999b, 2000; McPherson, French, & Kernodle, 2002; McPherson & Thomas, 1989) compared retrospective verbal reports of three age groups (10-11 years old, 12-13 years old, adults) of experts and novices between points in tennis. Findings indicated that, as expertise increased (from novice to expert), condition-action-goal sequences became more sophisticated and there was a distinct shift from goal-oriented to condition-action linkages. For example, novice tennis players might simply provide a goal of getting the ball in on their opponent's side of the court with no concern for the current game conditions. Due to a greater emphasis on conditions-actions, experts were able to develop situation prototypes and more sophisticated current event profiles. Additionally, if a person did not access sophisticated knowledge in situation interviews, he/she did not demonstrate sophisticated knowledge structures during performance.

French, et al. (1996) used "solution" as the unit of analysis for verbal reports of cognitive processes associated with a series of baseball game situations for a group of 7-10 year old baseball players. Defensive situations included: 1.) runner on first, no outs, and a groundball hit to centerfield; 2.) runner on first, no outs, groundball hit to second base; 3.) runner on second, one out groundball hit to left field; 4.) runner on second, one out, groundball hit to third base; and 5.) score tied, bottom of the sixth inning, runners on first and third, no outs, groundball hit to first base. Highly skilled players reported more

advanced solutions than less skilled players. More importantly, a qualitative analysis of less advanced solutions revealed some common errors in player thinking. These included: failure to attend or monitor critical game conditions (situations 4 and 5), poor prediction of actions within a certain time (situations 1,3,5), poor prediction of runners (situations 1,3,4,5,) and low level goals in situation two. Errors in monitoring critical game conditions included failure to activate critical game information into working memory while failing to make correct inferences from the critical game conditions provided in the problem statement. For example, in situation four players might have made the mistake of attempting to get a force out at third base when no force out was available at this base. In regards to situation five, players may not have realized the game would be over if the runner on third base scores. Additionally, players' answers were considered less advanced when they reversed them. For example, some players began with one solution, realized it was wrong and changed their solution. In actual competition, reversed answers would not have allowed the player to execute the solution within the time frame of game play. Low-skilled players reversed their answers more frequently than the average skill or high skilled players in situations four and five. The observed errors made by youth baseball players indicated that their knowledge bases did not include knowledge relevant to the situations presented, were not organized enough to facilitate retrieval, and led to poor predictions.

French, et al. (1996) described two factors which potentially influenced the content and structure of knowledge accessed during the defensive situations. First, due to the inability of this age group to execute the necessary motor skills, "motor skill level…..seemed to constrain the content and structure of tactical declarative and

procedural knowledge accessed during problem solution (French, et al., 1996, p. 394)." For example, some players stated that they would perform this action (throw to the pitcher) because they could not throw it all the way to first. Second, the practice and game experiences of players were not designed to enhance tactical development. Observations of game warm-up routines, games, and practices caused the authors to suggest that the "processing characteristics of good problem solvers (p. 394)" may not have been supported by the way these tasks were practiced. More specifically teams were never observed practicing with runners on base.

Nevett and French (1997) utilized a talk aloud protocol to analyze the thought processes of short stops at ages 8, 10, 12, and 16 during actual game performance. A micro-recorder was attached to the shortstop and recorded the shortstop verbalizing thought prior to each pitch. An experimenter stood behind the shortstop and prompted the player to verbalize what they were thinking prior to the pitch. Specific game situations were selected for analysis to control the game situations analyzed for each player. Most of the information accessed by eight year old shortstops was baseball information, but it was irrelevant to what the player should do if the ball was hit to him. By age 10, a majority of players accessed at least one solution if the ball was hit to him. At age 12, shortstops accessed more than one plan and began to rehearse more than one plan. At age 16, shortstops accessed more than one plan for the game situation, rehearsed plans after each pitch, modified plans based on changes in the game conditions, and were beginning to exhibit current event profiles.

The series of developmental studies in baseball and tennis provides some insight into the windows of time in which players are acquiring knowledge and creating new

knowledge structures. Collectively, the studies in baseball suggest that players are undergoing major changes in knowledge structures between the ages of 12 and 16. More research is needed to describe the changes that occur in knowledge structures between the ages of 12 and 16. Describing the practice histories of players at these ages may also provide some information regarding what types of practice and experience facilitates or hinders development of knowledge structures.

Purpose and intent of this study

The purpose of this study is to examine how changes in practice across age impact the development of high school and middle school baseball players' knowledge structures. In journal article one, retrospective interviews will be conducted with a sample of high school/middle school baseball players. The intent of the interviews is to obtain estimates of accumulated practice across each participant's career, estimates of practice hours per week during various parts of the year, descriptions of practice activities, and descriptions of coaches. In journal article two, situation interviews will be conducted with the intent of eliciting participants' knowledge structures of defensive play from a sample of baseball game situations. Defensive situations designed for this study include: (1) runner on first, no outs; (2) runner on second, one out; (3) runners on first and second, no outs; (4) runners on first and second, one out; (5) runner on third base, one out; (6) bottom of the 7th inning, runners on first and third, no outs; (7) 4th Inning – what are you thinking about defensively.

Specific research purposes to be addressed in journal article one include:

1. Do predictions from the theory of deliberate practice (early specialization, Ericsson, et al., 1993) or the Developmental Model of Sport Participation

(sampling a variety of sports, Cote, 1999) more accurately describe the practice history of junior varsity and varsity high school baseball players?

2. Describe high school players' hours of practice accumulated in different types of practice (regular season, post season, off-season, individual) and in the skills (batting, fielding, pitching) practiced during childhood and adolescence?
3. Describe the types of practices experienced by high school baseball players.
4. Describe the types and number of games played by high school baseball players.

Specific research purpose to be addressed in journal article two

1. Describe the knowledge structures of junior varsity and varsity baseball players.

Significance of the study

This study will contribute to two areas of literature. First, early specialization and sampling are two highly debated approaches to the development of elite sport performance. Studies conducted on elite athletes have indicated that expert performers begin practice earlier and accumulate more total practice time than non-elite athletes. Other studies indicated the opposite to be true. Specifically, experts sampled a variety of sports during the sampling stage of development (Cote, 1999) and began specializing in one sport between 15 and 16 years old. Little research exploring the developmental activities of high school-aged athletes exists. Cathey (2011) explored questions similar to the first three research questions of this study, but utilized an expert-novice paradigm to interview minor league baseball pitchers and pitchers who pitched in high school, but did not play collegiately or at another higher level. This study can provide a better understanding of early specialization in the development of expertise in baseball by using a younger sample representing a variety of defensive positions. Additionally, the use of

current high school baseball players may provide a more accurate reflection of practice histories, based on data from retrospective interviews, because participants are being asked to remember events from a shorter time frame.

Second, this study will contribute to the understanding of how knowledge structures change throughout development as a result of practice and game experience. French, et al. (1996) explored seven to 12 year old baseball players' knowledge representations of defensive situations during situation interviews. Findings indicated youth baseball players to have poorly developed knowledge representations of a series of defensive situations. The poorly developed knowledge representations were attributed to immature skill development, restricting their knowledge of defensive tactics, and to their practice and game experiences. While observing practice sessions, the authors noted that defensive situations with runners on base were rarely conducted. Nevett and French (1997) extended this research as they studied the knowledge representations of youth and high school baseball short stops using a talk aloud protocol during live game play. Findings indicated high school short stops provided more mature responses to game situations when compared to the youth short stops. When considering the aforementioned studies, it is obvious that between the ages of 12 and 16 baseball players are developing stronger knowledge representations of defensive situations. Potential explanations for this increase in knowledge relate to increases in skill level and the types of practice experienced by players at various ages. However, little research has been conducted on the knowledge representations of high school baseball players at infield positions other than short stop and different ages (junior varsity and varsity). This study can provide insight into the changes that occur in the knowledge representations of high

school baseball players by utilizing a sample that includes a wider variety of positions. Additionally, the use of two groups (junior varsity and varsity) will provide some sense of what is being learned by players across a two to four year span as a function of type of practice and game experience.

CHAPTER 2

DESCRIPTION OF HIGH SCHOOL BASEBALL PLAYERS' PRACTICE HISTORY[1]

[1] Wellborn, B.. & French, K.E. To be submitted to the *International Sport Coaching Journal.*

Simon and Chase (1973) reported grand chess masters to have accumulated an average of 10 years and 10,000 hours of experience leading to what has become known as the "10-year rule". Throughout the 1970's and 1980's the "10-year rule" was supported as the characteristic of expert performance in domains such as music, mathematics, tennis, swimming and long-distance running. However, it was not until 20 years later that the researchers attempted to describe the types of experiences necessary to achieve expert levels of performance as "deliberate practice" (Ericsson, Krampe, & Tesch-Romer, 1993). Essentially, the theory of deliberate practice postulates that performance levels attained are directly related to the amount of accumulated practice. The goal of deliberate practice is to improve performance through highly structured, and not inherently enjoyable, activities requiring physical and mental effort. The deliberate practice theoretical framework includes two predictions or assumptions. First, a monotonic relationship exists between the accumulated amount of time spent in deliberate practice and the level of achievement attained by an individual. Simply stated, the more deliberate practice one engages in, the greater the performance level. Second, individual differences in performance at a given age are directly related to the amount of accumulated deliberate practice. Individual differences can be attributed to starting age and the amount of weekly practice. Due to the linear relationship between age and deliberate practice, the earlier the starting age, the more accumulated deliberate practice. Additionally, when beginning deliberate practice at the same age, the individual accumulating more weekly deliberate practice will achieve a higher level of performance (Ericsson, et al., 1993). This has led some people to believe that expert levels of

performance are only attainable when participants specialize in a given domain at an early age.

In contrast to Ericsson et al.'s (1993) deliberate practice theory, Cote (1999), using in-depth qualitative interviews, presented the Developmental Model of Sport Participation (DMSP) to describe three phases of athlete development leading to an expert level of performance. Contrary to the deliberate practice theory which suggests early specialization, the DMSP includes a sampling phase where individuals voluntarily participate in a variety of activities without specializing in one, a specializing phase where athletes reduce the number of activities engaged in to one or two, and an investment phase where athletes specialize in only one activity. In addition to participating in multiple activities early in development, the distinguishing factor between the DMSP and deliberate practice is the role of deliberate play (Cote, 1999). Cote, Baker, and Abernethy (2003) described deliberate play as "developmental physical activities that are intrinsically motivating, provide immediate gratification, and are specifically designed to maximize enjoyment (p. 186)." Whereas Ericsson, et al. (1993) suggested that individuals should engage in large amounts of deliberate practice early, the DMSP reflected the roles of deliberate play and deliberate practice in the three phases of development. Specifically, individuals should engage primarily in deliberate play activities during the sampling years, equal amounts of deliberate play and deliberate practice activities during the specialization years, and primarily deliberate practice activities in the investment years. There is evidence to support both deliberate practice (early specialization) and the DMSP (early diversification).

Studies conducted on elite athletes have indicated that expert performers begin practice earlier and accumulate more total practice time than non-elite athletes. A series of studies on the developmental activities of English soccer players (Ward, Hodges, Starkes, & Williams, 2007; Ford, Ward, Hodges, & Williams, 2009; Ford & Williams, 2012) led to the early engagement hypothesis (Ford, et al., 2009). Ward, et al. (2007) used a cross-sectional design to study the development of under-18 years old soccer players in the English Football Association. Participants began soccer activities at the age of seven and after 11 years of involvement, elite soccer players accumulated 4,542 compared to 2,100 hours for the sub-elite. In addition, while elite soccer players engaged in 1,971 hours of playful activity compared to 2,890 for the sub-elite, the number of hours during the early years of soccer participation (ages 7-12) did not differ between the different skill groups. As a result, Ward et al. (2007) suggested that without significant deliberate practice, playful activities contribute relatively little to the development of elite performance.

Using the same data set from the Ward, et al. (2007) study, (Ford, et al., 2009) created three groups (still-elite, ex-elite, recreational) to explore differences in the developmental activities of soccer players between the ages of six and 12. Results indicated the two elite groups spent on average 235 hours/year engaged in deliberate practice activities. When multiplying this number times six, 1,410 accumulated hours were devoted to practice. In comparison, the recreational group averaged 87 hours/year (522 total hours). Additionally, still-elite athletes engaged in 40 hours/year of competition. Finally, Ford and Williams (2012) studied the developmental activities of 16 professional and 16 non-professional soccer players. Non-professional players were

those asked to leave youth soccer academies in England while professional players were given scholarships to become full-time athletes. All participants were 15 years old at the time of data collection. Results indicated that professional players were significantly younger (M=5.9 years old) than non-professional players (M=6.8 years old) when beginning their careers. All players began soccer competition between the ages of seven and eight. Additionally, players started elite training programs between 10 and 11 years old. Professional players, after 10 years of involvement, accumulated 4,840 hours of deliberate practice compared to 3,518 hours for non-professionals. In summary, soccer professional soccer players began their careers early, between the ages of 5 and 6 and accumulated more hours of practice compared to non-professional players. The early engagement hypothesis (Ford, et al., 2009) has been proposed as a possible explanation for the advancement to professional status.

Other studies (Soberlak & Cote, 2003; Berry, Abernethy & Cote, 2008; Memmert, et al., 2010) indicated experts sampled a variety of sports during the sampling stage of development and began specializing in one sport between 15 and 16 years old. Canadian ice hockey players reported 3,072 hours of deliberate practice and 3,506 hours of deliberate play between the ages of six and 20. In support of the DMSP, almost 15% of the deliberate practice hours and 75% of the deliberate play hours were completed during the sampling years (ages 6 to 12). Throughout the sampling years, the reported number of hours of hockey involvement was 460. Berry et al., (2008) found that Australian Football players participated in six to eight structured and playful activities throughout development and logged thousands of hours of deliberate practice (4,185), deliberate play (2,210), and non-Australian Football invasion games (1,359). Also

Memmert, et al. (2010) found that deliberate practice and play hours contributed significantly to the development of "creative" professional team ball sports players in Germany.

Little research exploring the developmental activities of baseball players exists. In their study of youth baseball players, French, Spurgeon, & Nevett (1995) found deliberate practice and deliberate play to have a significant impact on skill development. Highly skilled youth baseball players between the ages of 7 and 12 reported practicing baseball skills significantly more often than less skilled players. Some of the practice could be described as deliberate practice (practicing with supervision) and some could be described as deliberate play (unsupervised practice with friends). Highly skilled players exhibited superior performance in throwing for distance, throwing accuracy, batting, and catching than less skilled players at each age. Measures of throwing and fielding skills were also correlated with total practice time. It seems that both deliberate practice and deliberate play significantly impact the development of baseball motor skills between the ages of 7 and 12.

Cathey (2011) has also shown that deliberate practice and deliberate play significantly impacts the ability of minor league baseball pitchers to reach an expert level of performance. All participants (novices and experts) reported early engagement with baseball (beginning at age 5), as well as participating in an average of three sports between the ages of 5 and 16. Most novices began pitching between the ages of 7 and 12. Half of the experts reported beginning their pitching careers at young ages and half began pitching in high school. All of the experts either began pitching at young ages or played infield positions (short stop, third base) prior to initiation of pitching. Thus, all the

experts began practice of forceful throwing at a young age. By age 18, experts (M=5,424) accumulated more hours of baseball practice compared to novices (3,839). Additionally, experts (1,638) accumulated more hours of pitching practice than novices (M=895). While the findings supported the importance of early engagement in baseball, retrospective practice histories of minor league pitchers provide evidence for some of the predictions made by Cote, Baker, and Abernethy (2003). For example, baseball players sampled approximately three sports during the sampling years (5-12) and only specialized in baseball during adolescence.

More studies examining the practice and competition histories of high school baseball players are needed to determine the role of early specialization and non-specialization in the development of baseball players between the ages of 14 and 18. The use of current high school baseball players may provide a more accurate reflection of practice histories than adults, based on data from retrospective interviews, because participants are being asked to remember events from a shorter time frame. The purpose of this study was to describe the hours of practice accumulated in different types of practice (primary season, off-season, individual) and in the skills (offense, defense, pitching) practiced during childhood and adolescence by high school junior varsity and varsity baseball players. In addition, the types and number of competitive games played by high school junior varsity and varsity baseball players were described. The ultimate goal was to answer the question: do predictions from the theory of deliberate practice (early specialization, Ericsson, et al., 1993) or the DMSP (sampling a variety of sports, Cote, 1999) more accurately describe the practice history high school baseball players?

Method

Participants

The participants were 51 high school baseball players in the southeast United States. Participants were distributed among freshman (N=10), sophomores (N=8), juniors (N=22), and seniors (N=11). Parental consent was obtained from the parents of each participant. All participants completed informed assent.

Retrospective Interview

The retrospective interview protocol in this study was developed using principles from retrospective interviews previously reported (Soberlak & Cote, 2003; Cote, Ericsson, & Law, 2005; Ericsson, et al., 1993; DaMatta, 2004; Cathey, 2010). Interview questions were developed to aid participants' recall of significant experiences during their careers. A copy of the interview questions and charts used to prompt responses from participants is presented in Appendix B. Section one of the interview asked for information related to educational year, height, weight, age, birth date, handedness, player position(s), and a self-rating of their defensive capabilities.

Section two of the interview was designed to elicit participants' descriptions of current and past levels of performance beginning from age 5 to their current ages. Specifically, questions focused on participants' recall of their participation in all organized sports, estimated practice of baseball during the primary season, off-season, individual practice, and games played during the primary- and off-season. Participants were also asked at what age/playing level they recalled practicing defensive situations (i.e. bunt defenses, first and third situations, double plays, etc.) with runners on base.

Procedures

The first author contacted the head coaches of 10 high school baseball teams in the southeastern United States. Four coaches responded allowing access to their junior varsity and varsity players. Participants completed the questionnaires individually or as a small group in an area near the team's practice facilities where distractions were limited. The first author traveled to each team's location to conduct the sessions and remained with each player or group of players throughout the completion of the questionnaires to answer any questions.

Results

Participation in Baseball

Each participant indicated the age in which he began participating in baseball. Most participants (88.2%) began involvement in sports by age five and played between one and two sports per year until age seven. From ages eight to 12, most participants were involved in at least two sports. The mean number of sports played per year reached a maximum of 2.12 at age 10 and began to decrease during the remaining ages. The percentage of participants beginning baseball by age five was 82.4%. All participants had started baseball by age 10. In addition, 57% of players at age 10 and 82% at age 13 reported they were playing for multiple baseball teams each year. A qualitative analysis of the data showed that an increasing percentage of participants began to specialize in baseball during the specialization years at ages 13 (33.3%), 14 (45.1%), and 15 (59.1%). In the investment years, participants had committed almost entirely to baseball at ages 16 (81.8%) and 17 (83.3%).

Engagement in Deliberate Practice

Participants were asked to estimate the number of weeks and practices per week for the primary season, off-season, and individual practice periods at each age. In addition players were asked to estimate the length of practice sessions. To calculate the hours spent in practice during the primary season, off-season and individually at a given age, the number of weeks was multiplied by practices per week. This number was then multiplied by the estimated length of practice to determine the hours of practice at each age. The practice hours at each age were then added together to determine the accumulated hours of practice during the primary season, off-season and individual practice. To calculate accumulated practice hours for each player, the primary season, off-season and individual practice hours were added together. The average number of accumulated hours athletes engaged in deliberate practice activities between the ages of 5 and 14 was 3,179.78 hours (see Table 2.1). The average number of deliberate practice hours was highest during the primary season (M=1,443.90), followed by individual practice (M=1,152.40) and off-season (M=630.94).

Table 2.1

Means and standard deviations for total, primary-season, off-season and individual deliberate practice hours

	Ages 5-14 (N=51)	Ages 5-15 (N=44)	Ages 5-16 (N=34)	Ages 5-17 (N=27)	Ages 5-18 (N=11)
Total	3,179.78 (SD=1,863.12)	3,330.18 (SD=1,852.59)	3,393.82 (SD=1,909.28)	3,448.96 (SD=1,911.29)	3,662.18 (SD=1,450.60)
Primary Season	1,443.90 (SD=582.71)	1,534.52 (SD=566.09)	1,646.82 (SD=566.09)	1,702.93 (SD=535.53)	1,837.27 (SD=502.96)
Off-Season	630.94 (SD=459.83)	650.91 (SD=484.50)	634.29 (SD=467.47)	669.56 (SD=497.88)	883.60 (SD=609.56)
Individual Practice	1,152.40 (SD=1,608.31)	1,174.35 (SD=1,648.11)	1,151.01 (SD=1,715.10)	1,055.98 (SD=1,725.53)	1,037.60 (SD=1,143.98)

Figure 2.1 indicates the average number of hours of deliberate practice per year increased linearly between the ages of 5 and 14 and remained relatively constant between the ages of 14 and 18. Players reported a maximum number of hours at age 15 (M=470.94) and never dropped below 442 hours between 14 years of age and 18.

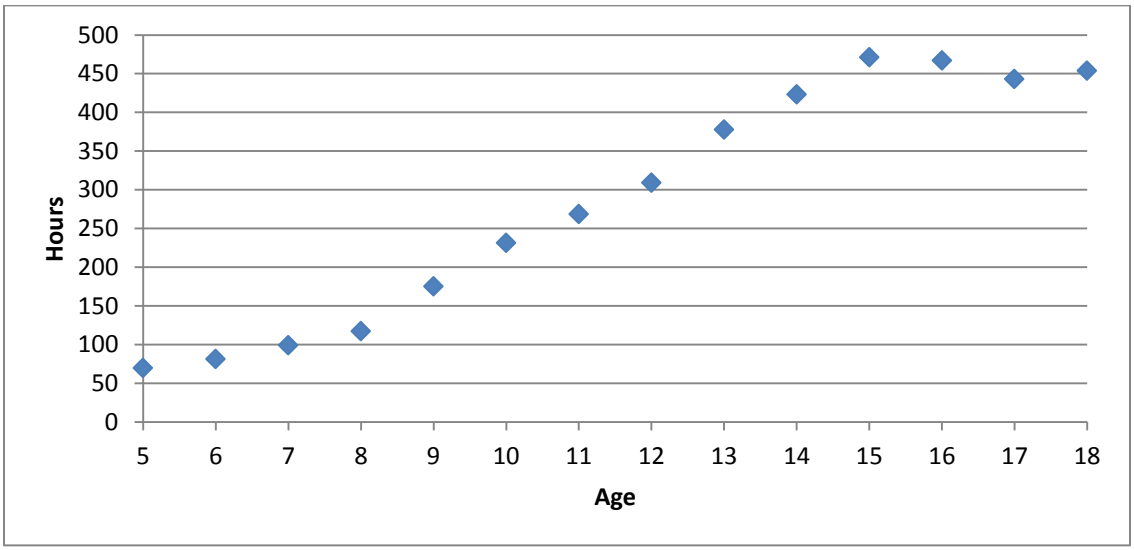

Figure 2.1 Total practice hours by age

Involvement in Baseball Games

Players were asked to estimate the length (in weeks) of their primary- and off-seasons as well as the number of games they played per week. The number of weeks was multiplied by the number of games to calculate the number of games played at each age for both the primary- and off-seasons. The total number of games played was then determined by summing the games played during the primary season and off-season.

The average number of accumulated games athletes participated in between the ages of 5 and 14 was 817. The average number of games played was highest during the primary season (M=473.86) compared to the off-season (M=386.82). Figure 2.2 illustrates the average total number of games played across age. Between the ages of five and eight, the mean number of games played ranged between 19.76 (age 5) and 34.55

(age 8). The average number of games played during the primary season increased linearly until the age of 12 while very few off-season games were being played before the age of 9. By age 9 the percentage of players participating on at least two teams increased from 21.2% to 47.1%, and average total games played per year increased from 34.55 to 60.35. At age 12, the mean number of total games played at a given age reached a maximum of 96.59. Throughout the high school years (ages 14-18), the mean number of games played remained consistent, ranging between 86.67 and 91.03. This pattern is similar to the one found for total practice hours and suggests a ceiling may exist for the amount of time invested in practice and the number of games played in a given year. More specifically, between the ages of 15 and 18, participants are practicing approximately 450 hours per year and playing approximately 88 games per year.

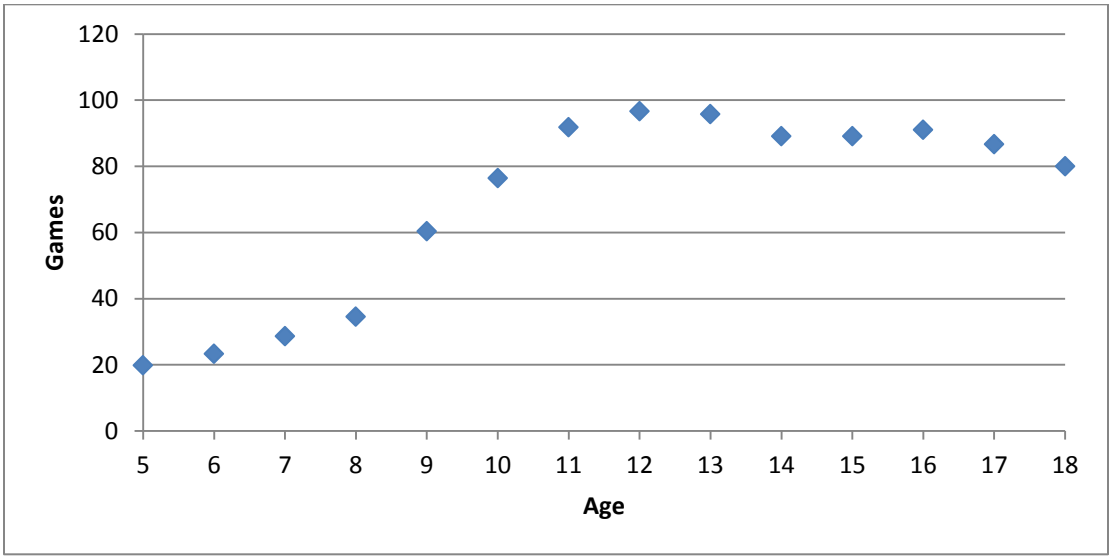

Figure 2.2 Total games played across age

Practice of Defensive Tactics

Figure 2.3 presents the percentage of players who were practicing with runners on base and receiving offensive or defensive signals across age. Overall, the percentage of

players who practiced defensive tactics increases across age. At age 5, when players are involved in tee ball, less than 10% of participants were practicing with runners on base and receiving signals from their coaches. By age 10, 80.4% of participants were practicing with runners on base and by 11 years of age 82.4% were receiving signals. Interestingly, by 14 years of age, approximately 5% of players indicated they still did not practice with runners on base.

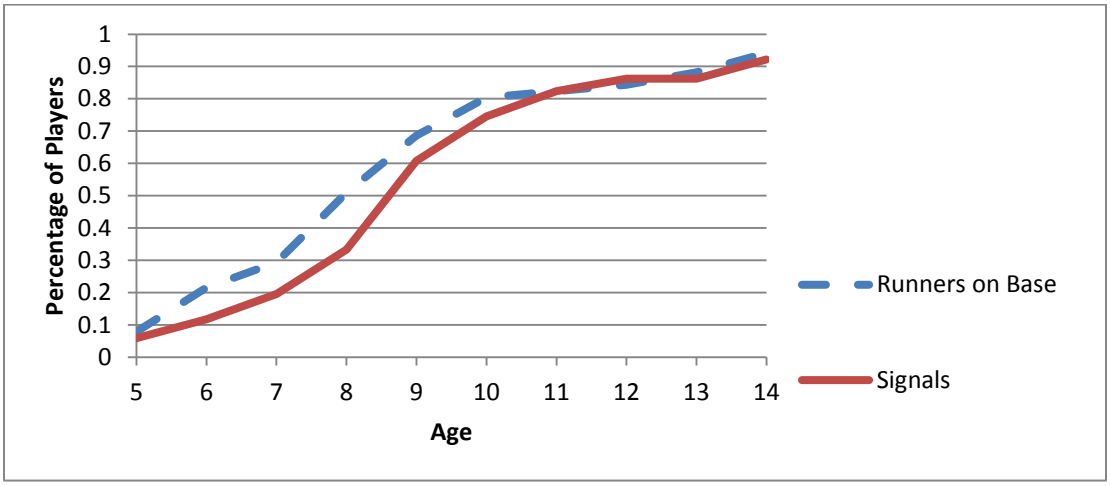

Figure 2.3 Percentage of participants practicing with runners on base and receiving signals

Figure 2.4 displays the percentage of players practicing specific defensive situations (bunts, first/third, double plays, cut-offs) from ages five to 14. Between the ages of five and 8, few players indicated they practiced defensive situations. By age 10, 72.5% practiced cut-offs, 68.6% practiced double-plays, 64.7% practiced bunts and 49.1 % practiced first and third situations. At 14 years of age all situations were being practiced by at least 86.3% of the participants.

A qualitative analysis of the defensive situations chart was conducted to determine if players listed any other situations they remembered practicing at each age. Additional defensive situations included pop-up communication (n=4), pick-offs (n=9),

tandem relays (n=9), run-downs (n=5), simulated games (n=1), base stealing (n=3), and trick plays (n=1). Except for pop-up communication, players listing these situations did so beginning at age eight. Pop-up communication began as early as 5 for one player.

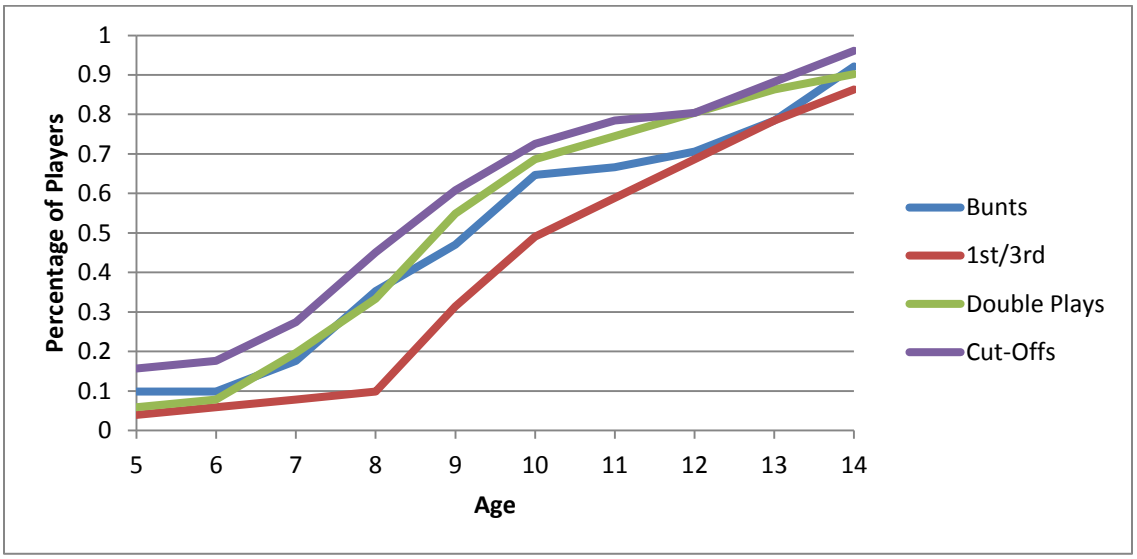

Figure 2.4 Practice of defensive situations across age

Defensive Positions Played Across Age

For each age, players were asked to list the positions they played. The list of positions played was translated into a frequency count. The mean number of positions played at age five for all participants was 5.12. At 14 years old, the average was 2.15. Figure 2.5 illustrates the average positions played across age for pitchers and catchers and figure 2.6 illustrates the average positions played across age for all other positions. Except for pitchers, all participants were playing fewer than three positions by age 12. At age 12, pitchers were still averaging four positions played. At the age of 14, pitchers (M=3.11) averaged playing more positions than any other position player. Catchers, second base, short stop and outfield averaged fewer than 2 positions played at the age of 14.

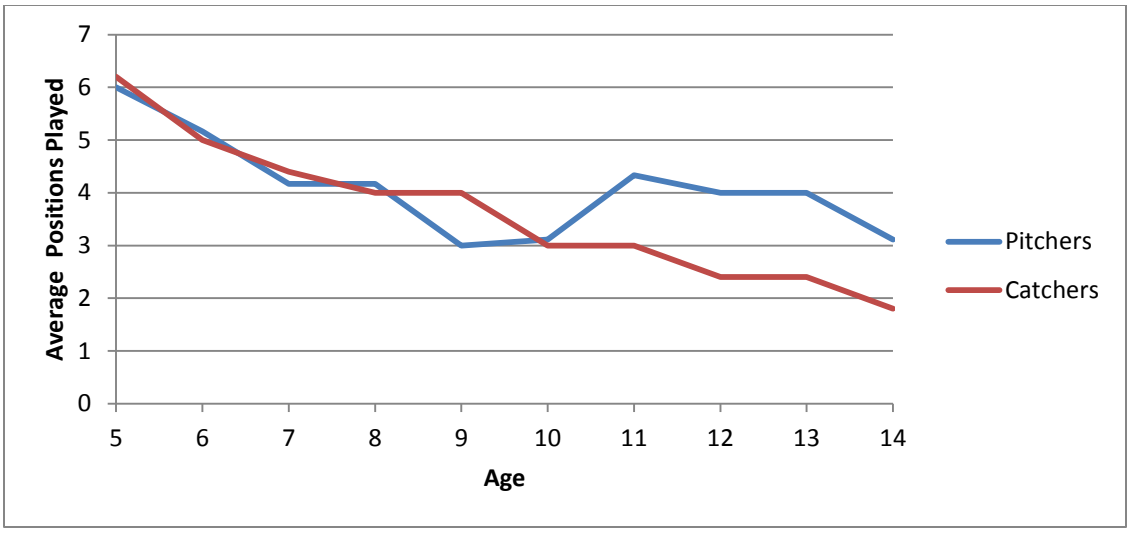

Figure 2.5 Average positions across age for pitchers and catchers

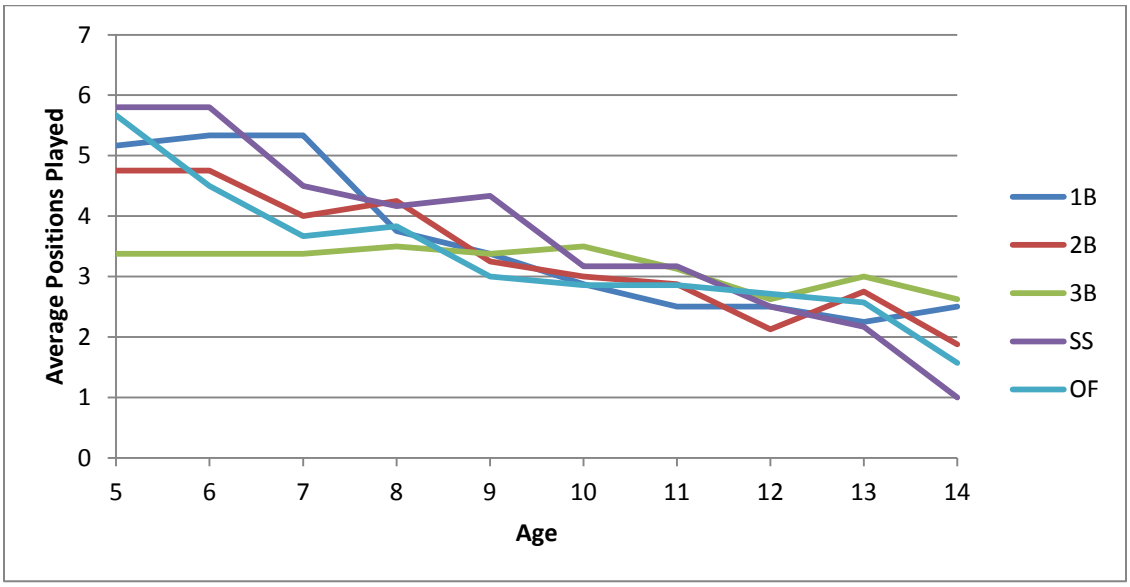

Figure 2.6 Average positions played across age for 1B, 2B, 3B, SS and OF

Discussion

One focus in this study was to describe the developmental histories of high school baseball players in relation to early specialization or diversification. Ericsson, et al. (1993) suggested that early engagement in domain-specific activities and thousands of hours of deliberate practice stretched across a minimum of 10 years is necessary to reach an expert level of performance. The Developmental Model of Sports Participation (Cote,

1999; Cote & Hay, 2002; Cote, et al., 2007) suggests that athletes sample a variety of sports and accumulate very little deliberate practice during the sampling years (ages 5-12), narrow to one or two activities during the specialization years (ages 13-15) and commit to large amounts of deliberate practice in one sport during the investment years (ages 16-18). Studies have supported both early specialization (Ericsson, et al., 1993; Ford, et al., 2007; Cathey, 2010; Smith, 2011) and early diversification (Soberlak & Cote, 2003; Berry, et al., 2008; Memmert, et al., 2010). Elite soccer players, under the age of 18 in the English Football Association, reported beginning soccer activities at the age of 7 and had accumulated over 4,500 hours after 11 years of involvement (Ward, et al., 2007). Elite players averaged 235 hours/year in deliberate practice activities between the ages of 6 and 12 (Ford, et al., 2009). When differentiating between professional and non-professional soccer players, Ford and Williams (2012) found that all players began soccer activities by the age of seven, were competing between the ages of seven and eight, and had begun elite training programs by the time they were 10 to 11. After 10 years of involvement, professional players had accumulated over 4,800 hours of deliberate practice and non-professional players had accumulated over 3,500 hours. In support of the DMSP, Canadian ice hockey players were found to participate in an average of six sports between the ages of 9 to 12 (Soberlak & Cote, 2003) and Australian National Team members from multiple sports reported having played an average of 8.6 other sports (Baker, et al., 2003). In addition, approximately 15% of the deliberate practice hours were completed during the sampling years compared to 72% during the investment years (Soberlak & Cote, 2003).

In this study, high school baseball players began at very early ages and accumulated a large amount of deliberate practice hours. The reported number of sports that participants played during the sampling years was less than studies supporting Cote's model. During the sampling years, participants in this study averaged fewer than two sports per year except at age 10 when the maximum number of sports played reached 2.12. Cote and colleagues have documented athletes sampling a wide variety of sports during the sampling years. These studies were conducted in Canada and Australia and may represent cultural differences when compared to the United States. This study and other studies conducted in the southeastern United States (baseball, Cathey, 2010; women's basketball, Smith, 2011), demonstrate specialization patterns consistent with Ericsson's predictions. In the United States, children may tend to specialize early in baseball (Cathey, 2010) and basketball (Smith, 2012). This may be due to the media coverage afforded to major sports such as football, basketball and baseball. Showcase and travel baseball leagues in the United States also promote early talent identification and provide the opportunity for players to be exposed to college and professional scouts. Many of the showcase baseball leagues offer teams for players as young as 7 and 8. The availability of such leagues encourages young baseball players to specialize early in their careers.

By the time of entering high school the accumulated hours of deliberate baseball practice were almost 3,200. Participants averaged approximately 3,600 practice hours by age 18 (N=11). Although the mean practice hours across a ten year period in this study (age 5 to 14) are similar to the accumulated practice hours reported across a ten-year span by novices in other studies exploring wrestling (Hodges & Starkes, 1996), Australian

football (Berry, et al., 2008), soccer (Ford & Williams, 2012), and minor league and high school baseball pitchers (Cathey, 2010), it may be that participants sacrificed practice time for game play. More than 50% of participants were playing for a minimum of two baseball teams per year by age 10. At 12 years of age, players were playing a peak average of 96 games per year. Overall, high school baseball players in this study reported a high number of practice hours. The hours of practice in this study are similar to the hours reported by high school baseball pitchers in Cathey's (2010) study. These findings suggest similar practice patterns may be necessary to be successful at the high school level. At 16, 17, and 18 years old, minor league baseball pitchers reported committing more hours during individual and off-season practice compared to the novices (Cathey, 2010). In this study the number of practice hours during the primary season remained consistent between the ages of 15 and 18. Therefore getting to the next level (i.e. minor league professional baseball) may require that more practice hours be devoted to both individual and off-season practice. More work is needed at the minor and major league levels to verify what types and amount of practice is necessary to negotiate transitions in the minor and major league levels.

Position Specialization

Hill (1993) provided one of the few descriptions of specialization of player position in baseball. He surveyed minor league baseball players in the Pacific Northwest. Players who had reached the minor leagues did not exhibit a pattern of early specialization at specific player positions. Most minor league players had pitched at some time during childhood or adolescence. But there was no clear pattern to specialize early in pitching. Cathey (2010) found that only half of minor league pitchers began

pitching prior to age 12. The only position that appeared to show any early specialization in Hill's (1993) study was catcher. Minor league catchers had a tendency to become catchers in adolescence. No other pattern of early player specialization was found. In the present study, high school baseball players reported playing a wide variety of positions (between 4 to 6 positions) between ages 5 and 9. The number or variety of different positions played by each player decreased across age. The average was two to three different positions by high school.

Youth sport researchers have encouraged coaches to allow young players to play a variety of different positions to encourage a broad base of skill development. Part of this recommendation was to avoid the potential negative affective effects often associated with playing right field or being identified as an unskilled player that could not be trusted playing every position. The players in this study were allowed to play a wide variety of player positions throughout childhood and adolescence. This may have been the result of positive coaching to allow players to try different positions. The players may also have been skilled at throwing, catching, and/or hitting at younger ages which gave coaches greater confidence that these players could be successful at a variety of positions. More research is needed to determine whether early specialization or early diversification of different player positions may facilitate or hinder development of baseball skills and knowledge at older ages or more advanced levels of play.

Few studies have examined development of tactics and the knowledge base in baseball or practice experiences that would facilitate the development of knowledge structures and the associated cognitive processes that underlie decision making. Previous studies in youth baseball have shown that young players have poor tactical development

– especially prior to age 10. While players under the age of 10 were aware of double plays, they performed poorly in problem solving and defensive situations that were more complex with runners on base and in scoring position (French, et al., 1995; French, et al. 1996; Nevett & French, 1997).

In this study players were asked to recall their practice experiences with defensive tactics. Before the age of 9, a low percentage of players reported practicing with runners on base and the defensive situations listed (i.e. bunts, first and thirds, double plays and cut-offs). At 10 years of age 80% of participants reported they were practicing with runners on base and between 50% and 72% were practicing the defensive situations listed. Surprisingly, at 14 years of age there were still players reporting they had not practiced with runners on base or the defensive situations. The findings related to the practice of defensive tactics under the age of nine support previous studies with younger players. Before the age of 9, players were not practicing defensive situations so they were unable to develop the knowledge base necessary to handle a variety of defensive situations (French, et al., 1995, 1996). French and colleagues (1995, 1996), in their field notes, said that teams rarely practiced with runners on base between the ages of 7 and 10. Part of their poor tactical performance may be due to the fact that they had not practiced the defensive situations. At younger ages players lack the necessary technical skills (such as throwing and catching) to play baseball. Tactics tend to develop as the rules change and skill level improves. Participants in the French, et al. studies (1995, 1996) were from a cohort of players who played for recreational baseball leagues. In this study, players were playing many games (817 by age 14) for their primary season teams as well as more advanced baseball leagues (i.e. travel and showcase) during the off-season. The

description of changes in defensive tactics in this study and when they were introduced provides useful information for researchers who are interested in what ages to examine and/or intervene with tactical development. Nevett and French (1997), in their talk-aloud data with young short stops, found that important transitions occurred between 10 years old and high school ages in the development of cognitive factors associated with game tactics. Further research is needed to understand how practice situations may influence tactical knowledge. Based on descriptive statistics in this study, it seems that important transitions are occurring between the ages of 10 and 12 in defensive tactics. More studies are needed to determine what types of interventions and practice activities can best facilitate tactical development in these age groups.

References

Baker, J., Cote, J., & Abernethy, B. (2003). Sport-specific practice, deliberate practice and the development of expertise in team ball sports. *Journal of Applied Sport Psychology, 15*, 12-25.

Berry, J., Abernethy, B., & Cote, J. (2008). The contribution of structured activity and deliberate play to the development of expert perceptual and decision-making skill. *Journal of Sport and Exercise Psychology, 30*, 685-708.

Cathey, M. (2010). Retrospective practice histories of expert and novice baseball pitchers. Unpublished doctoral dissertation, University of South Carolina, Columbia.

Cote, J. (1999). The influence of the family in the development of talent in sports. *Sports Psychologist*, 13, 395-417.

Cote, J., Baker, J, Abernethy, B. (2003). From play to practice. In J.L. Starkes & K.A. Ericsson (Eds) *Expert performance in sports: Advances in research on sport expertise* (pp. 89-113). Champaign, IL: Human Kinetics.

Cote, J., Ericsson, K.A., Law, M.P. (2005). Tracing the development of athletes using retrospective interview methods: A proposed interview and validation procedure for reported information. *Journal of Applied Sport Psychology, 17*, 1-19.

Cote, J., & Hay, J. (2002). Children's involvement in sport: A developmental perspective, in J.M. Silvia & D. Stevens (eds.), *Psychological foundations of sport* (pp. 484-502). Boston: Allyn & Bacon.

Ericsson, K.A., Krampe, R.T. & Tesch-Romer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review*, 100(3), 363-406.

Ford, P.R., Ward, P., Hodges, N.J., Williams. A.M. (2009). The role of deliberate practice and play in career progression in sport: the early engagement hypothesis. *High Ability Studies, 20*, 1, 65-75.

Ford, P.R., & Williams, A.M. (2012). The developmental activities engaged in by elite youth soccer players who progressed to professional status compared to those who did not. Psychology of Sport and Exercise, 13, 349-352.

French, K.E., Nevett, M.E., Spurgeon, J.H., Graham, K.G., Rink, J.E. & McPherson, S.L. (1996). Knowledge representation and problem solution in expert and novice youth baseball players. *Research Quarterly for Exercise and Sport*, 67, 386-395.

French, K.E., Spurgeon, J.H., & Nevett, M.E. (1995). Expert-novice differences in cognitive and skill execution components in youth baseball performance. *Research Quarterly for Exercise and Sport, 66*, 194-201.

Hill, G.M. (1993). Youth sport participation of professional baseball players. *Sociology of Sport Journal*, *10*, 107-114.

Hodges, N.J. & Starkes, J.L. (1996). Wrestling with the nature of expertise: A sport specific test of Ericsson, Krampe, and Tesch-Romer's (1993) theory of "deliberate practice". *International Journal of Psychology, 27*, 400-424.

Memmert, D., Baker, J., & Berrtsch, C. (2010). Play and practice in the development of sport-specific creativity in team ball sports. *High Ability Studies, 21*, 3-18.

Nevett, M.E. & French, K.E. (1997). The development of sport-specific planning, rehearsal, and updating of plans during defensive youth baseball game performance. *Research Quarterly for Exercise and Sport, 68*, 203-214.

Simon, H.A. & Chase, W.G. (1973). Skill in chess. American Scientist, 61, 394-403.

Smith, T. (2012). Retrospective practice histories of Division 1 and Division II female basketball players in the Carolinas. Unpublished doctoral dissertation, University of South Carolina, Columbia.

Soberlak, P. & Cote, J. (2003). The developmental activities of elite ice hockey players. *Journal of Applied Sport Psychology, 15*, 41-49.

Ward, P., Hodges, N.J., Starkes, J.L., & Williams, A.M. (2007). The road to excellence: Deliberate practice and the development of expertise. *High Ability Studies, 18* 119-153.

CHAPTER 3

DESCRIPTION OF HIGH SCHOOL BASEBALL PLAYERS' KNOWLEDGE STRUCTURES[2]

[2] Wellborn, B., & French, K.E. To be submitted to the *Journal of Sport and Exercise Psychology*

French and McPherson (2003) explain techniques associated with using verbal reports to elicit the thoughts of individuals as they solve static problems (situation interviews) and thought processes used during competition. Verbal reports, grounded in cognitive psychology, are commonly used as a way to report the content and cognitive processes associated with solving problems. Verbal reports are overt behaviors which must be interpreted through a theoretical framework of how verbal responses are produced. Ericsson and Simon (1993) provide the most useful model for collecting and interpreting verbal reports. Their model distinguishes between processing activities that are verbalizable and others that are not. Specifically, only information accessed to the level of working memory may be verbalized by individuals. The content verbalized is a sequence of thoughts activated into working memory during problem solving. Other processes (some perceptual and visual processing) are not directly verbalizable and require information to be translated into a verbal code. The output of the process (visual search, cue selected, or recognized) may then be verbalized. For example, if a short stop states that a runner occupies first base, it can be inferred that he conducted a visual search of the playing field first and then translated that search into a verbal code.

Ericsson and Simon assumed that "cognitive processes leave in long term memory a subset of the originally heeded information in the form of a retrievable trace of connected episodic memory (1993, p. 149). The use of retrospective verbal reports "involves retrieval of these episodic memories and verbalization of their content (1993, p. 149)." Thought processes verbalized during perceptual motor performances may interfere with the perceptual or motor performance. In these cases, retrospective interviews immediately after performance are the preferred method.

Talk aloud protocols have been used to examine sport experts' thoughts while solving static game problems (McPherson, 1999b, 2000; French, Nevett, et al. 1996) and during actual baseball games (Nevett & French, 1997). Retrospective interviews have been used to study thought processes during competition in tennis (McPherson, 1999a, McPherson & Thomas, 1989) and badminton (French, Werner, et al 1996).

When individuals are asked to solve static sport problems (i.e. report thoughts during performance using either retrospective recall or talk aloud), the individual only accesses a portion of the entire knowledge base. Thus, it is important to sample a variety of game situations so that the individual accesses a larger portion of the knowledge that is stored in long term memory. In specific game situations, the expert individuals will initially access the portion of the knowledge base that relates specifically to the game problem at hand. French and McPherson (1999) refer to the "process of accessing a portion of the entire knowledge base to perform a specific task as representation of the problem or problem representation (p. 179-180)." They go on to explain two important reasons for this conceptualization of problem representations. First, only a small amount of the person's knowledge base can be understood as they complete a specific sport task. This supports the use of multiple sport performance situations to better understand an individual's knowledge base. Second, novices may tend to access part of the knowledge base that is not the most critical to performing a specific performance task. Said another way, novices may be able to access a great amount of sport knowledge, but it is not the most critical or relevant knowledge necessary to perform the specific task. Each of the studies reported next have elicited knowledge structures and thought processes of participants using a variety of game situations (situation interviews) or have selected

sample of thought from actual game performance from specific game situations.

McPherson and colleagues (McPherson, 1999b, 2000; McPherson, French, & Kernodle, 2002; McPherson & Thomas, 1989) compared retrospective verbal reports of three age groups (10-11 years old, 12-13 years old, adults) of experts and novices between points in tennis. Findings indicated that, as expertise increased (from novice to expert), condition-action-goal sequences became more sophisticated and there was a distinct shift from goal-oriented to condition-action linkages. For example, novice tennis players might simply provide a goal of getting the ball in on their opponent's side of the court with no concern for the current game conditions. Due to a greater emphasis on conditions-actions, experts were able to develop situation prototypes and more sophisticated current event profiles. Additionally, if a person did not access sophisticated knowledge in situation interviews, he/she did not demonstrate sophisticated knowledge structures during performance.

French, et al. (1996) used "solution" as the unit of analysis for verbal reports of cognitive processes associated with a series of baseball game situations for a group of 7-10 year old baseball players. Defensive situations included: 1.) runner on first, no outs, and a groundball hit to centerfield; 2.) runner on first, no outs, groundball hit to second base; 3.) runner on second, one out groundball hit to left field; 4.) runner on second, one out, groundball hit to third base; and 5.) score tied, bottom of the sixth inning, runners on first and third, no outs, groundball hit to first base. Highly skilled players reported more advanced solutions than less skilled players. More importantly, a qualitative analysis of less advanced solutions revealed some common errors in player thinking. These included: failure to attend or monitor critical game conditions (situations 4 and 5), poor

prediction of actions within a certain time (situations 1,3,5), poor prediction of runners (situations 1,3,4,5,) and low level goals in situation two. Errors in monitoring critical game conditions included failure to activate critical game information into working memory while failing to make correct inferences from the critical game conditions provided in the problem statement. For example, in situation four players might have made the mistake of attempting to get a force out at third base when no force out was available at this base. In regards to situation five, players may not have realized the game would be over if the runner on third base scores. Additionally, players' answers were considered less advanced when they reversed them. For example, some players began with one solution, realized it was wrong and changed their solution. In actual competition, reversed answers would not have allowed the player to execute the solution within the time frame of game play. Low-skilled players reversed their answers more frequently than the average skill or high skilled players in situations four and five. The observed errors made by youth baseball players indicated that their knowledge bases did not include knowledge relevant to the situations presented, were not organized enough to facilitate retrieval, and led to poor predictions.

French, et al. (1996) described two factors which potentially influenced the content and structure of knowledge accessed during the defensive situations. First, due to the inability of this age group to execute the necessary motor skills, "motor skill level…..seemed to constrain the content and structure of tactical declarative and procedural knowledge accessed during problem solution (French, et al., 1996, p. 394)." For example, some players stated that they would perform this action (throw to the pitcher) because they could not throw it all the way to first. Second, the practice and

game experiences of players were not designed to enhance tactical development. Observations of game warm-up routines, games, and practices caused the authors to suggest that the "processing characteristics of good problem solvers (p. 394)" may not have been supported by the way these tasks were practiced. More specifically teams were never observed practicing with runners on base.

Nevett and French (1997) utilized a talk aloud protocol to analyze the thought processes of short stops at ages 8, 10, 12, and 16 during actual game performance. A micro-recorder was attached to the shortstop and recorded the shortstop verbalizing thought prior to each pitch. An experimenter stood behind the shortstop and prompted the player to verbalize what they were thinking prior to the pitch. Specific game situations were selected for analysis to control the game situations analyzed for each player. Most of the information accessed by eight year old shortstops was baseball information, but it was irrelevant to what the player should do if the ball was hit to him. By age 10, a majority of players accessed at least one solution if the ball was hit to him. At age 12, shortstops accessed more than one plan and began to rehearse more than one plan. At age 16, shortstops accessed more than one plan for the game situation, rehearsed plans after each pitch, modified plans based on changes in the game conditions, and were beginning to exhibit current event profiles.

The series of developmental studies in baseball and tennis provides some insight into the windows of time in which players are acquiring knowledge and creating new knowledge structures. Collectively, the studies in baseball suggest that players are undergoing major changes in knowledge structures between the ages of 12 and 16. More research is needed to describe the changes that occur in knowledge structures between the

ages of 12 and 16. The purpose of this study was to describe the knowledge structures of high school baseball players.

Methods

Participants

Twenty-five high school baseball players (six freshman, four sophomores, nine juniors, and six seniors) were recruited for this study. Participants recruited were infielders (1B (N=4), 2B (N=4), 3B (N=4), SS (N=4), pitchers (N=5), and catchers (N=4). Parental consent and player assent was gained prior to participation.

Situation Interviews

Situation interviews, focused on a series of defensive baseball situations, were conducted with each of the participants. The situation interview protocol designed for this study was developed using situation interviews previously reported in French, et al. (1996). A set of five situational questions was developed to elicit players' knowledge of a series of defensive baseball situations. Situations one through four provide players with game conditions including location of runners and number of outs in the inning. In addition to the location of runners and number of outs, situation five also provides the inning. Situations one through five are outlined in table 3.1.

Table 3.1

Baseball defensive situations

1.) Runner on first, no outs
2.) Runner on second, one out
3.) Runners on first and second, no outs
4.) Runner on third base, one out
5.) Bottom of the 7th inning, runners on first and third, one out

The five game situations were selected because the frequency in which they occur in games varies and the critical nature of successful execution varies. Situation 1 (runner on first, no outs) and 3 (runner on first and second, one out) will occur more frequently in games than situations 2 (runner on second, one out), 4 (runner on third, one out), and 5 (runner on first and third, bottom of the 7th, one out). Situation 2 was selected because the runner on second is not forced to run if the ball is put in play. Younger players made errors in this situation. Situation 4 and 5 are critical situations because a game may be won or lost if the runner on third scores. Teams often have specific first and third plays that are executed in game situation 5.

The action sequences that would be most appropriate if a ball was hit in the infield in situation 1 would be a double play. In situation 2, on a ball hit to the pitcher, shortstop, or third baseman, an appropriate action sequence would be to look the runner at second back to second base and throw to first. A ball hit to first base or second base, may or may not have a play for the runner at second who will likely run to third. The first or second baseman in this case, would look at the runner at second base and determine if there is a play, but would most likely throw to first to get an out.

In situation 4, if the score is close, players should try to prevent the runner at third from scoring. Often this would mean the infield would play closer to home plate (in field in) and try to prevent the runner from going home or throw to home to get the runner out at home. In situation 5, runners at first and third, one out, if the score of the game is close, preventing the runner at third from scoring is the most important goal. First and third plays would be run to try to either prevent the runner at first from stealing or trying to get the runner on third out by faking a throw to second if the runner on first attempts to

steal. Players would attempt to get a double play on a ball hit in the infield or attempt to get the runner out at home.

Procedures

The first author contacted the head coaches of 10 high school baseball teams in the southeastern United States. Four coaches responded allowing access to their junior varsity and varsity players. Participants completed situation interviews individually in an area near the team's practice facilities where distractions were limited. The first author traveled to each team's location to conduct the sessions.

Situations were presented to participants using a systematic process. First, participants were read an interview protocol instructing them to imagine themselves on the field in a number of game situations and to say out loud the thoughts they would be thinking. Second, participants were handed a packet of five baseball field diagrams. The situation was written on the bottom right of each page and the bases occupied were marked with an "X". After receiving a hard copy of the game conditions, the first author read each game situation aloud. Third, players were prompted with, "tell me about everything you are thinking" if they asked for additional information such as score of the game or inning. In addition, the prompt "anything else" was used to encourage the player to continue thinking aloud.

Data analysis

The situation interviews with players were transcribed. The verbal data was analyzed using procedural steps similar to those outlined in Chi's Verbal Analysis Method (Chi, 1997). Verbal protocols were first segmented into units of meaning. Sentences or phrases that referred to action sequences or individual or team actions in

baseball were segmented into categories that referred to specific action sequences that related to the specific situations. Each unit was then categorized into an action sequence category. The most common action sequence categories across situations were statements that referred to a bunt, controlling the run game (i.e., hold runner on base, pick off plays, steals), double plays, check the runner and throw to a base, lead runners, cutoffs with the outfield (includes tandem cutoffs), and pitch execution. Examples of player statements in these categories are presented in table 3.2. A more extensive list of 19 different player's statements categorized for each situation is presented in appendix F.

Table 3.2

Sample statements within the major categories across all situations

Pitch execution
Pitch him – pitching low and try to hit our spots (site 1 junior pitcher).
So probably preferably you'd pitch inside so if he does try to get it opposite field it's gonna be very weak, he might pop it up or something (site 3 junior pitcher).

Controlling the run game
Then I will check out the runner and if he has a big lead or something, maybe flash a quick pick (junior catcher).
If we think he's going to steal, we'll normally do some kind of timing stuff. I might hold it for three seconds. I might come set then go (site 1 junior pitcher).
Tell second baseman who's got the ball if he steals the bag depending on who's up to bat (site 2 junior short stop).

Bunt
If there is a bunt or something like that, I field which side I need to field and make a throw over to first (senior pitcher).
On a bunt, you have an L route to back up the first baseman. (site 3 senior 2B).

Double play
Hit hard at me, go to second and try to roll two (junior 3B).
Depending on the situation, if it's early in the game we would probably to second and first and get a double play. (site 3 senior shortstop).

Cut-offs involving the outfield
He's going to be going on contact, so if the ball's hit on the ground to center fielder or right fielder I know I have to be the cutoff man at home. (site 2 junior first basemen)

On a ball hit to the outfield, we have another tandem. That means cause it is a runner on first, and probably on this play probably going home with it and the shortstop and second basemen are going to line up (site 3 senior 2B).

Check runner
If there is a groundball to me, I will check the runner and then go to first (site 1 senior pitcher).
When the ball is hit, I will check him and if he's going I will throw it to third, but if there's really no play, I will just go to first (site 3 senior shortstop).

Infield in
Probably playing in with a guy on third, depending on who's up (site 1 senior 3B).
Well, if it's a close game, we'll be infield in (site 1 freshman 2B).

Lead runner
If the ball's hit deep in the hole, towards third base, if I don't have a chance in the middle, I might take the lead out at third. (site 2 junior short stop).
In this situation, you just try and get an out – specifically the lead runner (site 2 junior pitcher).

Two independent observers with extensive baseball experience separately categorized the units of baseball play from the transcripts of 10 players for each situation. Percent agreement was calculated to assess the reliability of observers to categorize the statements of players into baseball content categories for each situation. The percent agreement was 96% for situation 1, 92% for situation 2, 94% for situation 3, 99% for situation 4, and 95% for situation 5.

The frequency of player's who accessed at least one statement in a content category was determined for each baseball content category. If a player accessed at least one statement related to a given content category, the frequency for that category was coded as 1. If the player did not access at least one statement related to that category, the frequency was coded as zero. Although players may have made more than one statement related to a given content category, the frequency in a given category was still coded as one in that content category. This quantitative analysis was conducted to determine

which categories or action sequences were included in each player's solution to the situation and which action sequences were not accessed to the level of working memory in the player's verbalized solution to the situation.

Results

Good solutions to each game situation

The most important content categories and the frequency of players who access at least one statement related to the important action sequences are presented in table 3.3. Most players (80% or more) accessed double plays for situations 1, 3, and 5. A low percentage of players accessed conditions related to score (44%) for situations four and five and inning (8%) for situation four.

Table 3.3.

Frequency and percentage of players who accessed important content for each situation.

Situation	Important Content Category	Frequency of Players	Percentage of Players
Runner on first, no outs	Double Play	**20**	**80%**
Runner on second, one out	Look runner back, throw first	**12**	**48%**
Runner on first and second, no outs	Double Play	**21**	**84%**
	Get lead runner	**11**	**44%**
Runner on third, one out	Look runner back	**11**	**44%**
	Throw home	**20**	**80%**
	Score	**11**	**44%**
	Inning	**2**	**8%**
Bottom of 7th, runners on first and third, one out	First and third plays	**14**	**56%**
	Double play	**22**	**88%**
	Get lead runner	**8**	**32%**
	Score	**11**	**44%**

Other Position Responsibilities for Major Content Categories

In baseball, certain player positions have other specific responsibilities (bunt coverage, steals, pick offs, cutoffs) to perform in given game situations. The same two experienced individuals who coded the transcripts determined specific position responsibilities for each of the five game situations. These position responsibilities are summarized in table 3.4. The left side of table 3.4 lists the major content categories that were used as codes during the analysis process. The middle of table 3.4 displays position responsibilities (i.e. major content categories) for each of the five situations.

In situation 1, runner on first with no outs, the pitcher and catcher would have responsibilities regarding pitch execution, the pitcher, catcher, first baseman, second baseman, and shortstop would have responsibility for controlling the run game (steals, holding runner on base), the pitcher, catcher, first baseman, second baseman, shortstop and third baseman would have responsibilities if a batter bunted, the pitcher, catcher, first baseman, second baseman, shortstop, and third baseman would have responsibilities to complete a double play or attempt to get the lead runner out at second base. If the ball was hit to the outfield, the pitcher, catcher, first baseman, second baseman, shortstop, and third baseman may have responsibilities to serve as a cutoff for throws from the outfield. Two individuals with extensive baseball experience determined what player positions had specific responsibilities for given content categories that represented specific action sequences appropriate for each situation. This determination was important because different player positions have slightly different responsibilities in each situation. Thus, this analysis was conducted so that player responses in the interview could be judged in relation to specific responsibilities that a given player position should perform in a given

game situation. Thus, the table summarizes the specific player positions that should be involved in the major content categories for each game situation.

The right side of table 3.4 displays the maximum number of player responses by content category. The maximum number of player responses for each major content category was calculated by adding the number of players at each position across all situations. For example there are five pitchers and four catchers in the sample. The total possible number of pitchers and catchers who accessed a statement related to pitch execution in a given situation is 9. The total possible across all five situations would be 45 possible statements for pitch execution. The same method was used to calculate maximum player responses for the remaining content categories.

Table 3.4

Position responsibilities for major content categories

Major Content Categories	**Situations**					
	1	**2**	**3**	**4**	**5**	Player responses
Pitch Execution	P,C	P,C	P,C	P,C	P,C	45
Control Run Game	P, C, 1B, 2B, SS	P, C, 2B, SS, 3B	P, C, 1B, 2B, SS, 3B	P, C, 3B	P,C,1B,2B,SS,3B	105
Bunt	P,C,1B,2B,SS,3B	P,C,1B,2B,SS,3B	P,C,1B,2B,SS,3B	P,C,1B,2B,SS,3B	P,C,1B,2B,SS,3B	125
Double Play	P,C,1B,2B,SS,3B	n/a	P,C,1B,2B,SS,3B	n/a	P,C,1B,2B,SS,3B	75
Cut-Offs with OF	P,C,1B,2B,SS,3B	P,C,1B,2B,SS,3B	P,C,1B,2B,SS,3B	P,C,1B,2B,SS,3B	P,C,1B,2B,SS,3B	125
Check Runner/ Throw	n/a	P,C,SS,3B	n/a	P,C,1B,2B,SS,3B	P,C,1B,2B,SS,3B	67
Lead Runners	P,C,1B,2B,SS,3B	P,C,1B,3B	P,C,SS,3B	P,C,1B,2B,SS,3B	P,C,1B,2B,SS,3B	104

Knowledge Related to Other Responsibilities Accessed During Situation Interviews

The frequency of players accessing at least one statement in the major content categories is displayed in table 3.5. A percentage of players accessing at least one statement for each content category was calculated by dividing the frequency of responses for each content category across all situations by the maximum number of responses displayed in table 3.4. For example, when adding the frequency of players accessing statements related to "pitch execution" across the five situations, the total is 19. This frequency may then be divided by the maximum number of potential responses (45 – displayed in table 3.3). The percentage of players with the responsibility of accessing knowledge related to "pitch execution" who did access a statement related to pitch execution was 42.2%. The same calculation method was applied to the remaining content categories.

Table 3.5

Frequency of players who accessed at least one statement in the other responsibilities

Major Content Categories	**Situations**					
	1	**2**	**3**	**4**	**5**	% by content category
Pitch Execution	5	4	3	3	4	42.2%
Control Run Game	19	12	13	4	14	59.0%
Bunt	10	10	14	12	8	43.2%
Cut-Offs with OF	8	11	11	11	7	38.4%

Table 3.5 demonstrates that players did not consistently access information related to all of their primary responsibilities. The low percentage for pitch execution (42.2%) may be explained by the low sample size (N=9) as well as reports from catchers

that their coaches were calling pitches. If coaches are calling pitches, catchers do not have to consciously access information related to pitch execution. Considering four of the five situations (1, 3, 4, 5) presented prime opportunities to defend a bunt it was interesting that only 43.2% of players accessed information related to bunts. The offense is more likely to bunt in situations 1 and 3 because they have an opportunity to advance base runners to scoring position with one out. In situations 4 and 5, the offense may attempt a squeeze or safety squeeze bunt in effort to score the run from third when the score of the game is close in the late innings.

Frequency of players who verbalized a solution if the ball was hit to them

Table 3.6 displays the frequency of players indicating a solution for when the ball is hit to them. Sixty-eight percent of players provided a solution for situations 2, 3 and 4. Lower percentages were reported for situation 1 (52%) and situation 5 (56%).

Table 3.6

Frequency of players indicating a solution for when the ball is hit to them.

Situation	Total N=25	Total Percentage	Catcher N=4	First N=4	Pitcher N=5	Second N=4	Short stop N=4	Third N=4
1	13	52%	0	1	3	2	4	3
2	17	68%	0	3	3	4	4	3
3	17	68%	0	3	3	4	3	4
4	17	68%	0	4	2	3	4	4
5	14	56%	0	2	3	3	3	3

Errors in solutions

There were five players who accessed a less advanced solution in situation 4 or 5. Below are example quotes from each player:

Less advanced solutions in Situation 4, runner at third.

"If the infield's back you are just trying to get an out. They are going to, well our coaches say just get us an out. Just give them anywhere and then ball is hit, he gets an out. You just go onto the next batter (site 3 junior pitcher)."

"Anything on the left side, throw him out at first and then get him at home if there is time (site 3 junior first basemen)."

"Obviously, depending on the score and the situation in the game, but if it is hit at me, I am just going to go one (site 1 sophomore shortstop)."

These solutions do not account for the runner at third who would most likely score under the solutions given by the players above.

Less advanced solutions in Situation 5, runners at first and third, bottom of 7th inning

"Field cleanly where it is and just go to first with it just get the out (site 1 senior pitcher)".

Reversals

There were two instances in which players began verbalizing one solution, paused and then changed the solution to a more advanced solution. In French et al., (1996) these instances were defined as reversals. Below are examples for the players who reversed solutions during the verbalization of their answers to a given situation.

"I might play in front of the runner. (he was referring to infield in for a bunt) If I can turn a double play quickly enough we can get out of the inning without having to worry about the run. But, so, yeah, if I get a ground ball and it is a double play ball, I know I have to get rid of it quickly and get back to the bag and be able to make a good stretch cause getting the out, right there is going to be really important to make sure that run does not score (site 1 junior first baseman)".

"If it a close game, we will be infield in. Actually, no, no it wouldn't, middle infield would be back and we would be trying to turn two (site 1 freshman second baseman)

Alternative solutions based on fielding errors

Two players accessed alternative action plans based upon what they or a teammate would do in the event of a fielding error. Below are examples of quotes from these players:

"If I bobble it, throw it to first (site 3 freshman third baseman, situation 3)." This player had more than one statement similar to this in other situations.

"If I bobble it, just go one (site 2 sophomore middle infielder)".

Discussion

The knowledge content and the structure of the content verbalized by the high school players in this study was more advanced than the knowledge exhibited by younger baseball players in situation interviews (French et al., 1996) and younger shortstops verbalizing thoughts during actual games (Nevett & French, 1997). Compared to younger players in French et al., (1996, ages 8-10) and Nevett and French (1997, ages 8-12) the high school players in this study had more advanced solutions to game problems,

were much more accurate in predicting the actions of runners in game situations, verbalized more special plays with greater detail in bunt, steal, first and third situations, and explained in greater detail appropriate cutoff positioning. In addition, the high school players in this study had few reversals in their solutions and rarely accessed a contingency plan based upon a fielding or throwing error.

Previous studies of knowledge development in baseball (French et al., 1996, Nevett & French, 1997) found that few players below the age of 12 did not access advanced game solutions in situation interviews or during actual games. The high school shortstops in French and Nevett (1997) were able to access advanced solutions for what to do should the ball be hit to them and access special plays for bunts, steals, etc. as they prepared to defend between pitches during game play. Younger shortstops (under 12, French & Nevett, 1997) and younger players (situation interviews, French at al, 1996) did not retrieve advanced solutions and rarely accessed special plays. The majority of high school players in this study accessed a solution for what to do if the ball was hit to them (56% for situations 1 and 5, 68% for situations 2, 3, 4). In addition, high school players in this study accessed critical game information more often and verbalized more advanced plans for each game situation. Few less advanced solutions were verbalized by these players. In addition, many high school players also reported action sequences related to their position primary duties in pitch execution (42%), bunts (43%), controlling the run game (59%), and cutoffs (38%).

The content accessed by high school players was largely accurate in each situation. The largest deficit in the responses of the high school players in this study appeared to be related to omission of some aspects of the tactical knowledge of what to

do in the situations rather than the accuracy of what players did access. Not all high school players accessed a plan for what to do if the ball should be hit to them. Not all players included statements or plans for bunts, controlling the run game, or responsibilities for cutoff positioning and receiving the ball. These findings suggest that these high school players were still developing their knowledge base. It is possible that the high school players do possess more knowledge of these situations than they accessed during the interviews and did not express it verbally during the interview.

French et al., (1996) and Nevett and French (1997) suggested that one of the primary reasons for the poor performance of younger baseball players' tactical performance was the lack of practice experiences that would facilitate tactical development. These authors observed practices of the younger players. Rarely did the participants practice tactics with runners on base. Coaches and fans often prompted players during the game on where to throw to ball or what to do in game situations. In addition, some coaches thought that the player's skill development did not warrant practice time toward advanced tactics because younger players could not execute the skills needed for advanced tactics.

The high school players in this study had more experience with baseball than the participants in the previous two studies (French at al., 1996; Nevett & French, 1997). The participants of this study were also participants in journal article one of this dissertation. Players in this sample began organized baseball participation at approximately 5 years of age. They had accumulated more than 3,000 hours of practice and had participated in an average of 817 games. More importantly, by age 9, over 50% of the participants reported practicing with runners on base. Between 60 and 80 percent

of these participants reported practicing defensive tactics related to bunts, first and third, double plays, and cutoffs by 11 years of age. Over 80% reported practicing these tactics when the interviews were conducted. Thus, the high school players reported more experience with tactical baseball instruction beginning at younger ages than the participants in previous studies.

Despite the considerable years of experience, accumulated practice, and reported initiation of practice of tactics at young ages, the high school players in this study still did not access all the relevant information related to their primary responsibilities in the five game situations. There were gaps and omissions by participants in every situation. This suggests players are still developing baseball tactical knowledge and even high school players still have much more to learn in relation to tactics.

Other developmental studies of tactical development by McPherson and colleagues (McPherson, 1999a, 1999b, 2000, McPherson &Thomas, 1989) indicate that the knowledge base for tactics (tennis) develops slowly over an extended period of time. The research to date, has attempted to describe this slow process by documenting changes in the content and structure of tactical knowledge development in cross-sectional samples of age and expertise. The findings of this study suggest the process of tactical development is slow in baseball as well. Cathey (2010) found that minor league pitchers were just learning to "think like a pitcher". All the minor league pitchers in Cathey's study had high school coaches who called all the pitches when they were pitchers in high school. In the minor leagues, the pitching coach was introducing them to activities to analyze batters strengths, weaknesses, their own strengths and weaknesses as a pitcher, etc. Coaches required minor league pitchers to keep a journal of what worked and did

not work in practice and games throughout the season. The pitching coach would review journals with each pitcher every week. Most minor league pitchers in this study described themselves as beginning to think like a pitcher, rather than just a person to throw strikes with velocity. Thus, tactical development in pitching continues into the minor leagues.

More work is needed to begin to identify and describe practice experiences that promote growth in tactics and knowledge development. Most of the research on deliberate practice has focused on the quantitative accumulation of practice rather than the quantity and quality of practice that is related to a particular learning outcome, i.e., skill improvement or tactical development. More work is need to explore the time and quality of practice experiences that are necessary to improve skill outcomes and tactical changes in perceptual and knowledge structures that underlie the cognitive components of performance. Surveys of practice experiences or interviews with players to describe practice experiences would provide one way to identify and describe meaningful practice activities for knowledge development. Micro-structure analyses of participant behaviors in practice sessions could provide more objective and accurate representations of practice experiences that do promote or do not promote improvement and change in skill or tactics. Once practice experiences that facilitate specific outcomes can be better understood and identified, more work can be directed toward interventions that may be better than the ones that are currently employed by coaches at every developmental level.

References

Cathey, M. (2010). Retrospective practice histories of expert and novice baseball pitchers. Unpublished doctoral dissertation, University of South Carolina, Columbia.

Chi, M.T.H. (1987). Representing knowledge and meta-knowledge: Implications for interpreting meta-memory research. In F.E. Weinart & R.H. Kluwe (Eds.). Metacognition, motivation, and understanding (pp. 239-266). Hillsdale, NJ: Lawrence Erlbaum.

Ericsson, K.A. & Simon, H.A. (1993). *Protocol Analysis: Verbal reports as data*. Cambridge, MA: The MIT Press.

French, K.E. & McPherson S.L. (2004). Development of expertise in sport. In M.R. Weiss (ed.), Developmental sport and exercise psychology: A developmental perspective (pp. 403-423). Morgantown, WV: Fitness Information Technology, Inc.

French, K.E. & McPherson, S.L. (1999). Adaptations in response selection processes used during sport competition with increasing age and expertise. *International Journal of Sport Psychology, 30*, 173-193.

French, K.E., Nevett, M.E., Spurgeon, J.H., Graham, K.G., Rink, J.E. & McPherson, S.L. (1996). Knowledge representation and problem solution in expert and novice youth baseball players. *Research Quarterly for Exercise and Sport*, 67, 386-395.

French, K.E., Spurgeon, J.H., & Nevett, M.E. (1995). Expert-novice differences in cognitive and skill execution components in youth baseball performance. *Research Quarterly for Exercise and Sport, 66*, 194-201.

French, K.E. & Thomas, J.R. (1987). The relation of knowledge development to children's basketball performance. *Journal of Sport Psychology, 9*, 15-32.

French, K.E., Werner, P.H., Rink, J.E., Taylor, K., Hussey, K. (1996). The effects of a 3-week unit of tactical, skill, or combined tactical and skill instruction on badminton performance of ninth grade students. *Journal of Teaching in Physical*, 15, 418-438.

McPherson, S.L. (1999a). Expert-novice differences in performance skills and problem representations of youth and adults during tennis competition. *Research Quarterly for Exercise and Sport, 70,* 233-251.

McPherson, S.L. (1999b). Tactical differences in problem representations and solutions in collegiate varsity and beginner women tennis players. *Research Quarterly for Exercise and Sport, 70*, 369-384.

McPherson, S.L. (2000). Expert-novice differences in planning strategies during collegiate singles tennis competition. *Journal of Sport and Exercise Psychology, 22*, 39-62.

McPherson, S.L., French, K.E., & Kernodle, M.W. (2002). Expert-novice differences in problem representations of male professionals and novices during singles tennis competition.

McPherson, S.L. & Kernodle, M.W. (2003). Tactics, the neglected attribute of expertise: Problem represnetations and performance skills in tennis, in: J.L. Starkes & K.A. Ericsson (Eds) *Expert performance in sports: Advances in research on sport expertise* (137-168). Champaign, IL: Human Kinetics.

McPherson, S.L., & Thomas, J.R. (1989). Relation of knowledge and performance in boys tennis: Age and expertise. *Journal of Experimental Child Psychology, 48*, 190-211.

Nevett, M.E. (1996). Knowledge content, sport specific strategies, and other self-talk accessed by shortstops of different ages during defensive game play. Unpublished doctoral dissertation, University of South Carolina, Columbia.

Nevett, M.E. & French, K.E. (1997). The development of sport-specific planning, rehearsal, and updating of plans during defensive youth baseball game performance. *Research Quarterly for Exercise and Sport, 68*, 203-214.

CHAPTER 4: DISCUSSION

The purpose of the first study was to determine whether predictions from the theory of deliberate practice (early specialization, Ericsson, et al., 1993) or the Developmental Model of Sport Participation (sampling a variety of sports, Cote, 1999) more accurately described the practice history of high school baseball players. Participants (n=51) began at an early age (5) and were playing year round for multiple baseball teams by age 10. In addition, total accumulated hours of practice for these high school players were similar to the hours for a different sample of high school players (Cathey, 2010). After 10 years involvement (between the ages of 5 and 14), players had accumulated an average of 3,200 practice hours. Similar patterns of practice and early engagement maybe necessary to become a successful high school baseball player. Results supported a trend toward early specialization and accumulation of deliberate practice (Ericsson, et al., 1993).

The purpose of the second study was to describe the knowledge structures of high school players. Interviews on five baseball defensive situations were conducted with 24 high school baseball players. Player responses were transcribed and analyzed for knowledge content. Results indicated high school players have more accurate and advanced knowledge structures than younger players. The high school players in this study reported practicing more advanced tactics at early ages. Future research is needed to determine what types of interventions and practice activities can best facilitate tactical development in these age groups.

Further, studies describing the practice and competition histories of high school baseball players are needed to determine the role of early specialization and non-specialization in the development of baseball players between the ages of 14 and 18. In addition future research is needed to determine what types of interventions and practice activities can best facilitate tactical development in these age groups.

References

Abernethy, B., Burgess-Limerick, R., & Parks, S. (1994). Strategies for improving understanding of motor expertise (or mistakes we have made and things we have learned). In J.L. Starkes & F. Allard (eds.), *Cognitive issues in motor expertise*, (317- 356). Amsterdam: Elsevier.

Anderson, J.R. (1976). *Language, memory, and thought*. Hillsdale, NJ: Erlbaum.

Anderson, J.R. (1982). Acquisition of cognitive skill. *Psychological Review, 89*, 369-406.

Baker, J., Cote, J., & Abernethy, B. (2003). Sport-specific practice, deliberate practice and the development of expertise in team ball sports. *Journal of Applied Sport Psychology, 15*, 12-25.

Baker, J., Cote, J., & Deakin, J. (2005). Expertise in ultra-endurance triathletes early sport involvement, training structure, and the theory of deliberate practice. *Journal of Applied Sport Psychology (17)*, 64-78.

Berry, J., Abernethy, B., & Cote, J. (2008). The contribution of structured activity and deliberate play to the development of expert perceptual and decision-making skill. *Journal of Sport and Exercise Psychology, 30*, 685-708.

Bloom, B.S. (ed.) (1985). *Developing talent in young people*. New York: Ballantine Books.

Bullock, Nicola, Gulbin, Jason, Martin, David T., Ross, Angus, Holland, Terry, & Marino, Frank (2009). Talent identification and deliberate programming in skeleton: Ice novice to Winter Olympian in 14 months. *Journal of Sports Sciences, 27* (4): 397-404.

Cathey, M. (2010). Retrospective practice histories of expert and novice baseball pitchers. Unpublished doctoral dissertation, University of South Carolina, Columbia.

Cote, J. (1999). The influence of the family in the development of talent in sports. *Sports Psychologist*, 13, 395-417.

Cote, J., Baker, J, Abernethy, B. (2003). From play to practice. In J.L. Starkes & K.A. Ericsson (Eds) *Expert performance in sports: Advances in research on sport expertise* (pp. 89-113). Champaign, IL: Human Kinetics.

Cote, J. Baker, J. & Abernethy, B. (2007). Practice and play in the development of sport expertise. In G. Tenenbaum and R.C. Eklund (Eds.), Handbook of Sport Psychology (pp. 184-202). Hoboken, New Jersey: John Wiley & Sons, Inc.

Cote, J., Ericsson, K.A., Law, M.P. (2005). Tracing the development of athletes using retrospective interview methods: A proposed interview and validation procedure for reported information. *Journal of Applied Sport Psychology, 17*, 1-19.

Cote, J., & Hay, J. (2002). Children's involvement in sport: A developmental perspective, in J.M. Silvia & D. Stevens (eds.), *Psychological foundations of sport* (pp. 484-502). Boston: Allyn & Bacon.

Da Matta, G.B. (2004). The influence of deliberate practice and social support systems on the development of expert and intermediate women volleyball players in Brazil. Unpublished doctoral dissertation. University of South Carolina, Columbia.

Deakin, J.M. & Cobley, S. (2003). A search for deliberate practice: An examination of the practice environments in figure skating and volleyball. In J.L. Starkes & K.A. Ericsson (Eds) *Expert performance in sports: Advances in research on sport expertise* (pp. 115-136). Champaign, IL: Human Kinetics.

Ericsson, K.A. (2008). Deliberate practice and acquisition of expert performance: A general overview. *Academic Emergency Medicine, 15*, 988-994.

Ericsson, K.A. (2006). The influence of experience and deliberate practice on the development of superior expert performance. In K.A. Ericsson, N.Charness, P. Feltovich, & R.R. Hoffman (Eds.), Cambridge handbook of expertise and expert performance (pp. 685-706). Cambridge: Cambridge University Press.

Ericsson, K.A., Krampe, R.T. & Tesch-Romer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review*, 100(3), 363-406.

Ericsson, K.A. & Simon, H.A. (1993). *Protocol Analysis: Verbal reports as data*. Cambridge, MA: The MIT Press.

Ford, P.R., Ward, P., Hodges, N.J., Williams. A.M. (2009). The role of deliberate practice and play in career progression in sport: the early engagement hypothesis. *High Ability Studies, 20*, 1, 65-75.

French, K.E. & McPherson S.L. (2004). Development of expertise in sport. In M.R. Weiss (ed.), Developmental sport and exercise psychology: A developmental perspective (pp. 403-423). Morgantown, WV: Fitness Information Technology, Inc.

French, K.E. & McPherson, S.L. (1999). Adaptations in response selection processes used during sport competition with increasing age and expertise. *International Journal of Sport Psychology, 30*, 173-193.

French, K.E., Nevett, M.E., Spurgeon, J.H., Graham, K.G., Rink, J.E. & McPherson, S.L. (1996). Knowledge representation and problem solution in expert and novice youth baseball players. *Research Quarterly for Exercise and Sport*, 67, 386-395.

French, K.E., Spurgeon, J.H., & Nevett, M.E. (1995). Expert-novice differences in cognitive and skill execution components in youth baseball performance. *Research Quarterly for Exercise and Sport, 66*, 194-201.

French, K.E. & Thomas, J.R. (1987). The relation of knowledge development to children's basketball performance. *Journal of Sport Psychology, 9*, 15-32.

French, K.E., Werner, P.H., Rink, J.E., Taylor, K., Hussey, K. (1996). The effects of a 3-week unit of tactical, skill, or combined tactical and skill instruction on badminton performance of ninth grade students. *Journal of Teaching in Physical*, 15, 418-438.

Helsen, W.F., Starkes, J.L., & Hodges, N.J. (1998). Team sports and the theory of deliberate practice. *Journal of Sport and Exercise Psychology, 20*, 12-34.

Hodge, T., & Deakin, , J. (1998). Deliberate practice and expertise in the martial arts: The role of context in motor recall. *Journal of Sport and Exercise Psychology, 20*, 12-34.

Hodges, N.J., Kerr, T., Starkes, J.L., Weir, P. & Nananidou, A. (2004). Predicting performance from deliberate practice hours for triathletes and swimmers: What, when and where is practice important? *Journal of Experimental Psychology: Applied,* 10, 219-237.

Hodges, N.J. & Starkes, J.L. (1996). Wrestling with the nature of expertise: A sport specific test of Ericsson, Krampe, and Tesch-Romer's (1993) theory of "deliberate practice". *International Journal of Psychology, 27*, 400-424.

Janelle, C.M. & Hillman, C.H. (2003). Expert performance in sport: Current perspectives and critical issues, in: J.L. Starkes & K.A. Ericsson (Eds) *Expert performance in sports: Advances in research on sport expertise* (pp. 19-48). Champaign, IL: Human Kinetics.

Johnson, M.B., Tenenbaum, G., & Edmonds, W.A. (2006). Adaptation to physically and emotionally demanding conditions: The role of deliberate practice. *High Ability Studies, 17*, 117-136.

McPherson, S.L. (1999a). Expert-novice differences in performance skills and problem representations of youth and adults during tennis competition. *Research Quarterly for Exercise and Sport, 70,* 233-251.

McPherson, S.L. (1999b). Tactical differences in problem representations and solutions in collegiate varsity and beginner women tennis players. *Research Quarterly for Exercise and Sport, 70*, 369-384.

McPherson, S.L. (2000). Expert-novice differences in planning strategies during collegiate singles tennis competition. *Journal of Sport and Exercise Psychology, 22*, 39-62.

McPherson, S.L. & Kernodle, M.W. (2003). Tactics, the neglected attribute of expertise: Problem represnetations and performance skills in tennis, in: J.L. Starkes & K.A. Ericsson (Eds) *Expert performance in sports: Advances in research on sport expertise* (137-168). Champaign, IL: Human Kinetics.

McPherson, S.L., & Thomas, J.R. (1989). Relation of knowledge and performance in boys tennis: Age and expertise. *Journal of Experimental Child Psychology, 48*, 190-211.

Nevett, M.E. (1996). Knowledge content, sport specific strategies, and other self-talk accessed by shortstops of different ages during defensive game play. Unpublished doctoral dissertation, University of South Carolina, Columbia.

Nevett, M.E. & French, K.E. (1997). The development of sport-specific planning, rehearsal, and updating of plans during defensive youth baseball game performance. *Research Quarterly for Exercise and Sport, 68*, 203-214.

Memmert, D., Baker, J., & Berrtsch, C. (2010). Play and practice in the development of sport-specific creativity in team ball sports. *High Ability Studies, 21*, 3-18.

Rumelhart, D.E. & Norman, D.A. (1978). Accretion, tuning, and restructuring: Three modes of learning. In J.W. Cotton & R. Klatzsky (Eds.), Semantic factors in cognition (pp. 37-53). Hillsdale, NJ: Erlbaum.

Shulman, L.S. (1986). "Paradigms and research programs in the study of teaching." In M.C. Wittrock (Ed.), Handbook of research on teaching (3rd ed., pp. 3-36). New York: MacMillan.

Simon, H.A. & Chase, W.G. (1973). Skill in chess. American Scientist, 61, 394-403.

Smith, T. (2012). Retrospective practice histories of Division 1 and Division II female basketball players in the Carolinas. Unpublished doctoral dissertation, University of South Carolina, Columbia.

Starkes, J.L., (2000). The road to expertise: Is practice the only determinate? *International Journal of Sport Psychology, 31*, 431-451.

Tenenbaum, G. (2003). Expert athletes: An integrated approach to decision making, in: J.L. Starkes & K.A. Ericsson (Eds) *Expert performance in sports: Advances in research on sport expertise* (pp. 191-218). Champaign, IL: Human Kinetics.

Ward, P., Hodges, N.J., Starkes, J.L., & Williams, A.M. (2007). The road to excellence: Deliberate practice and the development of expertise. *High Ability Studies, 18*, 119-153.

Young, B.W. & Salmela, J.H. (2002). Perceptions of training and deliberate practice of middle distance runners. *International Journal of Sport Psychology, (33)*, 167-181.

APPENDIX A: INTERVIEW PROCEDURES

I am conducting a research project to understand some of the factors that facilitate development of decision making in baseball. I would like you to answer some questions about your history as a baseball player. Primarily, I am interested in the types of practice experiences and competitive experiences you have engaged in across your career. These practice and competitive experiences include ones associated with baseball, as well as other sports you might have engaged in throughout your history. The interview includes some questions about your experiences and requires you to help me complete some charts that identify important details of your practice history. These charts are in your packet. The interview takes about 60 to 90 minutes. If you are willing, we will begin the interview now.

Section 1.

1.) We will start with some basic demographic information which is located on the first page of your interview packet. (**Introduction form**)
   a. What is your educational year (freshman, sophomore, junior or senior)?
   b. What is your height/weight?
   c. What is your birth date?
   d. Do you throw left or right-handed?
   e. Do you bat left or right-handed?
   f. What position(s) do you currently play? What is your primary position?
   g. What position(s) have you played in the past?
   h. On a scale of 1-10, how would you rank yourself on your defensive capabilities?

Section 2.

2.) Using the forms located in your packet, answer the following questions about your history specifically: **(Organized Sports Table)**
   a. At what age did you begin playing baseball?
   b. In the baseball column, list the type of league in which you were involved (i.e. t-ball, coach-pitch, machine pitch, player pitch, stealing allowed, etc.
   c. In each column where you indicated you participated in baseball, please record the number of teams you played for during that particular year.

d. In each column where you indicated you participated in baseball, please record the number of head coaches you played for during that particular year.
e. For the other columns mark the columns for any other organized sports you participated in.

3.) Think back to practices for the teams you played on across your career. Using the charts, please indicate the following for each year you played baseball. (**Primary Season Practice Schedule**) – Primary Season is defined as being part of the regular season (while games are being played) for your primary team in the spring/early summer. The beginning of the Primary Season is the date you began team practices.
   a. When was the start date of the season?
   b. What was the end date of the season?
   c. What was the length of practices?
   d. How many times did you practice with the team per week?
   e. How many games did you play per week?
   f. What positions did you play?
   g. How much time did you spend at practice focused on defense?
   h. How much time did you spend at practice focused on offense?
   i. How much time did you spend at practice focused on pitching?

4.) Using forms in your packet, can you answer the following questions about your off-season practice history: (**Off-season Practice Schedule**). Off-season is defined as the periods during the year when you were practicing with a group/team or playing for additional teams (USSSA, AAU, Showcase, etc.), but were not competing in regular season games with your primary team.
   a. Did you play for other teams (USSSA, AAU, Showcase, Travel, etc.) in the off-season? If so, how many different teams did you play for?
   b. Did you practice during the off-season?
   c. How many times did you practice per week?
   d. How long did you practice each time?
   e. With whom did you practice?
   f. How much time did you spend at practice focused on:
      i. Defense?
      ii. Offense?
      iii. Pitching?
   g. How many games did you play per week?

5.) Using forms in your packet, can you answer questions about your individual practice history: (**Individual Practice**). Individual practice is defined as the periods during the year when you were practicing for baseball (with the intention of improving baseball-related skills) outside of team practice (i.e. batting practice at a local batting cage, hitting lessons, pitching lessons,

throwing on your own, fielding ground balls, speed and agility training, strength and conditioning etc.)

a. Did you receive private hitting, fielding, throwing, pitching, etc. lessons? If so, for each age, what time of year did you participate in these sessions, how many weeks per year, how many sessions per week, how long were the sessions, and with whom did you practice?
b. Did you play "pick-up" games related to baseball (not directly supervised by a coach such as sandlot baseball) at any point in your career? If so, for each age, how many games did you play per week and with whom did you play?

6.) Some players and teams participate in strength and conditioning activities. Using the **Strength and Conditioning Chart**, please answer the following questions for each age:

a. Have you participated on teams requiring strength and conditioning/speed and agility sessions? If so, indicate these teams for each age you played on the chart. What time of year did your team participate in these activities, how many sessions per week, how long were the sessions, and who conducted the sessions (i.e. head baseball coach, assistant baseball coach, strength and conditioning coach, etc.)?
b. Have you/Do you participate in individual training sessions (outside of team practices) focused on strength and conditioning/speed and agility? If so, for each age, what time of year, how many sessions per week, how long were the sessions, and with whom did you practice?

7.) Some players participate in camps throughout their careers. If you attended any camps, can you list them according to the age you participated in them and what they focused on? (**Camps Table**)

8.) There is a page for awards or accomplishments next. Write down some of your individual and team accomplishments for each year of participation. (**Awards Table**)

9.) We will now move to some questions focused specifically on defensive situations in baseball. (**Defensive Situations**)

a. At what age/playing level do you remember practicing defensive situations?
b. At what age/playing level do you remember practicing defensive situations with runners on base?
c. At what age/playing level do you remember receiving signals from your coach?
d. Can you list the defensive situations you practiced throughout your career at specific ages/playing levels?

10.) We will now focus on injuries you might have sustained throughout your career. (**Injury History Table**)

a. Have you ever been injured?
b. What age/playing level?
c. What type of injury?
d. How did it occur?
e. How long did it take to recover?
f. For each year of participation, rate your health from 0 to 100%. 0% means you had an injury which prevented you from participating in baseball for that season. 100% means you were injury-free that season.

Section 3. – The following questions are not answered based on the use of a table.

11.) Describe what your high school baseball practices are like? (**let them answer before these questions**)
   a. Can you tell me how your practices are organized?
   b. Can you tell me how you warm-up specifically?
   c. Can you tell me more about what you do during practice specifically related to hitting?
   d. Can you tell me more about what you do during practice specifically related to defense?

12.) How do you prepare defensively during games? (Let them answer before asking these questions)
   a. Tell me what you think about while you are playing defense during a game.

13.) What do you consider to be your greatest strength as a defender? Why?

14.) What do you consider to be your greatest weakness as a defender? Why?

15.) Looking over your history of organized athletic events, you had a variety of experiences. Why did you choose baseball?

OR

Looking over your history of organized athletic events, you played very few other sports. Why did you choose to specialize in baseball so early?

DEVELOPMENT OF HIGH SCHOOL BASEBALL PLAYERS
DISSERTATION PROJECT

Introduction

I am conducting a research project to understand some of the factors related to the development of defensive decision making skills in high school baseball players. I would like you to answer some questions about your history as a baseball player and, more specifically, your development as a defensive player. Primarily, I am interested in the types of practice experiences and competitive experiences you have engaged in across your career. The interview includes some questions about your experiences and requires you to help me complete some charts that identify important details of your practice history. These charts are in a packet. The interview takes about 60 to 90 minutes. Thank you for your willingness to help me with this project. If you are willing, we will begin.

Demographic Information:

Educational Year: Fr. So. Jr. Sr.

Height:_____ **Weight:**_____

Birth date:_____

Throws: Left Right

Bats: Left Right

60-yard sprint time: _____

Position(s) you currently play: _____ **Primary Position:**_____

Positions you've played in the past:_____

On a scale of 1-10, how would you rank yourself on your defensive capabilities?: _____

Organized Sports Participation

For the baseball column indicate the type of game played (T-ball, coach pitch, little league, USSSA, AAU, JV, Varsity, Showcase, etc.)

Age at which you started playing organized baseball:

_____

For the other columns below please place a checkmark in the column if you participated in those sports at the specific ages listed.

Age	Organized Baseball			Other Sports									
	Baseball	# of Teams	# of Coaches	Football	Basketball	Soccer	Track &	Cross	Lacrosse	Golf	Tennis	Wrestling	Other
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													

Primary Season Practice Schedule

							Time at Practice		
Age	**Start of Season**	**End of Season**	**Length of Prac.**	**Practices per Wk**	**Games per wk**	**Pos(s) Played**	**Def**	**Off**	**Pitch**
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									

Off-Season Practice Schedule

								Time at Practice		
	# of Teams	Start of Season	End of Season	Length of Practice	# Practices per week	Games per Week	Position(s) played	Defense	Offense	Pitching
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										

Individual Practice

Age	**Time of Year**	**# of Weeks**	**Practices per week**	**Length of Practice**	**With Whom**	**Focus**
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						

Strength and Conditioning Chart

	Team Strength and Conditioning Activities					Individual Strength and Conditioning Activities				
Age	**Time of Year**	**# of Wks**	**Sessions per week**	**Length of Session**	**With Whom**	**Time of Year**	**# of Weeks**	**Sessions per week**	**Length of Sessions**	**With Whom**
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										

Camp Participation

Age	# of Camps Attended	Camp Focus	Camp Type (i.e. Showcase, Instructional, Skill-Development).
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			

Awards (Accomplishments)

Age	Team Awards/Accomplishments	Individual Awards/Accomplishments
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		

Injury History

Age	Injury (yes/no)	Type of Injury	How Injury Occurred	Recovery Time	Rate your Health
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					

Defensive Situations Table

Age	Playing Level (i.e. H.S. Varsity, JV, T-Ball, etc.)	Practiced with Runners on Base (yes/no)	Coached used signals (yes/no)/ Signals related to what?	List the defensive situations you remember practicing (i.e. bunt defense, 1st/3rd, double plays, cut-offs, etc.)
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				

APPENDIX B: DEFENSIVE SITUATION INTERVIEW PROTOCOL

Baseball players often have a lot to think about while they are playing defense. I am trying to find out what kinds of things you think about when you are playing _____. I want you to imagine yourself on the field in a number of situations. In each situation, I want you to talk through, out loud, what you would normally be thinking in these situations. Try to think through these as you normally would in a game situation and just say out loud the thoughts that you would be thinking.

*I will use the prompt **"Tell me about everything you're thinking"** if the player asks where the ball is hit, what inning it is, etc.*

*I will use the prompt **"Anything else"** to encourage the player to continue thinking aloud.*

1.) Runner on first, no outs

2.) Runner on second, one out

3.) Runners on first and second, no outs

4.) Runners on first and second, one out

5.) Runner on third base, one out

6.) Bottom of the 7th inning, runners on first and third, one out

I am going to ask you one more question. This time, however, I am not going to provide you with the current game conditions. Please talk about what you are thinking when playing your defensive position.

7.) What are you thinking about when you go to your defensive position to begin the 4th inning?

APPENDIX C: CONSENT FORM

"Description of retrospective practice histories and knowledge structures of high school baseball players"

Your son is invited to participate in a study describing the practice histories and knowledge of high school baseball players. My name is Ben Wellborn and I am Graduate Student at The University of South Carolina, Department of Physical Education and Athletic Training. This study will be helpful in determining elements of practice history and describing the development of knowledge structures throughout the careers of high school baseball players. I am asking for permission to include your son in this study because his participation will contribute to our knowledge of how high school baseball players develop. I expect to have 42 participants in the study.

If you allow your son to participate, Ben Wellborn will conduct a two-part 60-minute interview during fourth period (Baseball class) at the high school. Part one of the interview is designed to collect demographic information (i.e. height, weight, player position, handedness, educational level), elicit participants' descriptions of current and past levels of performance beginning from age 5 to their current ages, and elicit information related to participants' high school baseball practices (i.e. descriptions of practices). Part two is a situation interview designed to assess players' knowledge of a series of defensive situations in baseball.

Any information that is obtained in connection with this study and that can be identified with your son will remain confidential and will be disclosed only with your permission. His responses will not be linked to his name or your name in any written or verbal report of this research project.

Your decision to allow your son to participate will not affect your or his present or future relationship with The University of South Carolina. If you have any questions about this study, please ask me. If you have any questions later, call Ben Wellborn at (828) 719-1304 or Dr. Karen French at (803) 777-3172. If you have any questions or concerns about your son's participation in this study, call Thomas Coggins, Director of the Office of Research Compliance, at (803) 777-7095.

You may keep a copy of this consent form. You are making a decision about allowing your son to participate in this study. Your signature below indicates that you have read the information provided above and have decided to allow him or her to participate in the study. If you later decide that you wish to withdraw your permission for your son to participate in the study, simply tell me. You may discontinue his participation at any time.

_____
Printed Name of Your Son

_____ _____
Signature of Parent(s) or Legal Guardian Date

I have read the description of the study titled 'Description of retrospective practice histories and knowledge structures of high school baseball players', and understand what the procedures are and what will happen to me in the study. I have received permission from my parent(s) to participate in the study, and I agree to participate in it. I know that I can quit the study at any time.

_____ _____
Signature of Minor Date

_____ _____
Signature of Investigator Date

For IRB Staff Use Only
University of South Carolina
IRB Number: Pro00029911
Date Approved 10/28/2013
Version Valid Until: 10/27/2014

APPENDIX D: COPY OF PILOT INTERVIEW FOR DEFENSIVE SITUATIONS

Situation 1: Runner on first, no outs

Runner on first, no outs, trying to get a ground ball to roll two, um, as a catcher, I'm going to be backing up the throw to first. Pop fly to the outfield, trying to catch it and get it in. A line drive, catch and look to first to see if he got off the bag. Um, a hit, get it in to third, so he doesn't get the bag. A double, probably gonna….. throw four but hit the cutoff man so he doesn't score. Wild pitch, go get the ball before he can get to third. On a bunt, looking two and going one probably.

(Anything else)

I don't know, I could probably sit here for another hour and think of something.

(Tell me about everything you're thinking)

I'm just thinking the different situations – what could happen and then places I need to be which would be backing up or if it's a hit, I need to be lining up the infielders for the cutoff. Talking to them and telling them where to throw the ball. Is that the kind of answer you're looking for?

(Anything else?)

That's about it.

(Keep the runner on first, no outs, Groundball hit to second base)

Goin' two. He's going to throw to the shortstop covering second and then back to first.

(Anything else?)

Well, if it's a slow roller, or a ball hit into the hole, and he can't turn, just go to first.

(Anything else?)

That's it.

SITUATION 2: RUNNER ON SECOND, ONE OUT

Ground ball to the left side of the infield, checkin' the runner, going one. Groundball to the right side of the infield, we don't have a play on it, cause he's going to take off just as soon as he sees it hit that way, we don't have a play, get the out at first. Check him at third, make sure we keep him there. Ball hit right at an outfielder, we probably have a play at the plate, throwing four. Hit back to the pitcher, check two, go one. A bunt, as a catcher, I'm going to have to see how far it is off the bag at second, but we're probably not gonna have a play on it – if it's a good bunt, but if it's a bunt right out in front of the plate, I might go three if I think we've got a play. Um, a groundball, I'm no longer backing up first base as a catcher cause we might have a play at the plate. Um……fly ball to right field, runner's probably going to tag up and go. Fly ball to centerfield, he might try it and fly ball to left field, he's probably not going to move. Um…..as a catcher I need to give more than one sign so I don't get my sign stole. A bunt, third baseman's no longer going to be charging, pitcher'll cover that side of the infield, first baseman will be up on a bunt. That's it.

(Same thing, you've got the runner on second and one out, and you have a groundball hit to third base)

Check the runner at second, go one.

(Anything else)

I think that's it.

SITUATION 3: RUNNERS ON FIRST AND SECOND, NO OUTS

Runners on first and second, again the third baseman's going to be covering the bag on the bunt, pitcher'll be covering that way on a bunt. As a catcher, I'm still changing up my signs. Now, if the ball's hit to the left side of infield we can go three or the short stop can turn a double play with the second baseman, but if it's hit to third, we need to step on it and go one. Right side, try to roll it with the second baseman, I mean shortstop at second base. Porbably not going to be able to throw this guy out from the right side of the infield. (Throw which guy out at third?) The guy on second. Hard grounder back to the pitcher go three. Soft groundball back to the pitcher, check three just in case and then most likely go one. Ball hit to the outfield, guy on second 's probably scoring if it finds a gap. A hard hit to the outfield straight at somebody, we might be able to cut him down at home. If it's a sure double, we're gonna be going three. I think that's it.

(Anything else).

(Shook his head no).

(Runner on first and second , no outs and a bunt to the third base side)

Alight, third baseman's going to be covering the bag if…if the pitcher has to run all the way over there, we're probably not going to get the guy at third, but we'll check him just in case and go one. If it's a hard bunt and it gets past the pitcher, the third baseman's gonna have to come off the bag and make a play at first. That's it….or if it barely goes out in front of the plate, the catcher might have a chance to throw the guy out at third. That's it.

(Okay, anything else)

That's it.

SITUATION 4: RUNNERS ON FIRST AND SECOND, ONE OUT (8:00)

Alright, now, anything up the middle we're gonna be looking to turn two between the short stop and second baseman. Groundball to first base, go one – uh – go to second base. Hopefully the pitcher'll cover the bag, or if he's close enough he can get back to the bag. Sharp ball hit to third that's carrying him to the third base line, tag the bag, go one. A ball carrying him to second base, go to second and one. The catcher is again changing signs. Um, on a bunt, we're still probably looking one unless it's right at somebody. In the outfield, to right field, a fly ball caught, the guy might try to tag and centerfield he might tag, left field he's not gonna tag. Um, a sure double we're goin' three cause that guy's gonna score. Um, the pitcher's still covering this side on a bunt, I don't know if I said that. The first baseman'll be playin' up just in case of a bunt. Um, that's it.

(So, runners on first and second, one out, and a groundball hit to the shortstop)

A groundball hit to the shortstop – turn a double play with the second baseman.

(Anything else)

If it's in the hole, he might just have to go one. I think that's it.

SITUATION 5: RUNNER ON THIRD BASE, ONE OUT (10:00)

You play the infield in depending on the situation in the game – if you need to cut down a runner, then a groundball at somebody we've got a chance to throw him out. If we're playing back, anything on the infield we're probably not gonna throw him out at home. Ball hit to third, we're gonna check him and go one. Back to the pitcher, check him and go one. Pass ball, pitcher needs to cover home plate. Anthing to the outfield is most likely going to score him, so we don't really have a play there, unless it's a shallow fly ball. Um, might squeeze. In that case we just need to make a play – probably go one.

Unless he gets a bad break. (what do you mean by bad break). If he breaks late when the guy bunts it - slow start. (and before you mentioned, at the very beginning of this you said it depends on the situation – tell me more about what you're thinking about in terms of depends on the situation). If it's a close game, in the late innings, we might need to keep them from scoring that run. If it's a team, uh, if we have a team that we know can't score many runs and we're a defensive team, we might play in and try to keep them from scoring that run because you never know how many runs we might need. But if we're a team you know we can hit the ball and score runs every game, we would just play back and give up that run for an out. I think that's it for that.

(Anything else)

Shakes head no.

SITUATION 6: WHAT ARE YOU THINKING ABOUT WHEN YOU GO TO YOUR DEFENSIVE POSITION IN THE FOURTH INNING?

Well, the fourth inning, as a catcher, I knew we've been through the order at least once, so I know what everybody's done and I remember the pitches we used to get them out, so I'm thinking about what I'm going to call to help our pitchers get the hitters out based on what they did last time. And I'm also going to know where they hit the ball to so I'm trying to help everybody line up in the right spot. (so tell me more about you calling pitches based on what they did last time – so what are you thinking about). If I know that they were slow getting around on the fastball, I'm going to stay with the fastball. If I know they got around on the fastball, we're going to try to mix it up some more. If we messed up and threw a curve ball and we slowed their bat down for 'em I know we won't do that again – we'll stay fastball and I know where on the plate we might pitch 'em.

(Anything else)

SITUATION 7: BOTTOM OF 7TH INNING, RUNNERS ON FIRST AND THIRD, ONE OUT.

Dang, before I even squat down I'm going to make the call for what we do with the first and third situation – knowing what we're gonna do – throw through or what not. I'm probably thinking I wanna throw this guy out and be a hero, but, that's just me. Trying to think about what kind of pitch I can use to get a ground ball, possibly a double play. I got my – I got the middle infielders back in double play depth – I got the corners in. I'm thinking what I'm gonna do if the ball's hit everywhere. Um, (now tell me more about that – what might you be thinking about). Well, if it's a sharply hit ball to third, we're gonna check the runner and turn two, um, I'm thinking if the ball is hit softly up the middle we might get one out and not two and the run will score. Ball hit back to the pitcher – check the guy at third – we're gonna go one. Anything in the outfield is probably gonna be bad – probably gonna score on a tag up. I'm thinking as a catcher I gotta block everything and not let that run score on a wild pitch or passed ball. Um, that's about it.

(Anything else)

That's it.

APPENDIX E: ANALYSIS OF SITUATION 2

SITUATION 2: RUNNER ON SECOND, ONE OUT

Ground ball to the left side of the infield, checkin' the runner, going one. Groundball to the right side of the infield, we don't have a play on it, cause he's going to take off just as soon as he sees it hit that way, we don't have a play, get the out at first. Check him at third, make sure we keep him there. Ball hit right at an outfielder, we probably have a play at the plate, throwing four. Hit back to the pitcher, check two, go one. A bunt, as a catcher, I'm going to have to see how far it is off the bag at second, but we're probably not gonna have a play on it – if it's a good bunt, but if it's a bunt right out in front of the plate, I might go three if I think we've got a play. Um, a groundball, I'm no longer backing up first base as a catcher cause we might have a play at the plate. Um……fly ball to right field, runner's probably going to tag up and go. Fly ball to centerfield, he might try it and fly ball to left field, he's probably not going to move. Um…..as a catcher I need to give more than one sign so I don't get my sign stole. A bunt, third baseman's no longer going to be charging, pitcher'll cover that side of the infield, first baseman will be up on a bunt. That's it.

Series of Condition/Action Sequences or If/Then Linkages

- Ground ball to the left side of the infield, checkin' the runner, going one
- Groundball to the right side of the infield, we don't have a play on it, cause he's going to take off just as soon as he sees it hit that way, we don't have a play, get the out at first. Check him at third, make sure we keep him there.

- Ball hit right at an outfielder, we probably have a play at the plate, throwing four
- Hit back to the pitcher, check two, go one
- A bunt, as a catcher, I'm going to have to see how far it is off the bag at second, but we're probably not gonna have a play on it – if it's a good bunt, but if it's a bunt right out in front of the plate, I might go three if I think we've got a play.
- a groundball, I'm no longer backing up first base as a catcher cause we might have a play at the plate
- fly ball to right field, runner's probably going to tag up and go
- Fly ball to centerfield, he might try it and fly ball to left field, he's probably not going to move
- as a catcher I need to give more than one sign so I don't get my sign stole
- A bunt, third baseman's no longer going to be charging, pitcher'll cover that side of the infield, first baseman will be up on a bunt.

APPENDIX F: EXTENDED RESULTS FOR JOURNAL ARTICLE 1

Specialization

Number of sports. The survey asked participants to list all sports played from age 5 to the present, the age at which they started playing baseball, and the number of baseball teams they played for at each age. Means for the total number of sports played at each age were calculated and are present in table F.1.

Table F.1

Average sports played per year

5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.49	1.69	1.82	1.98	2.06	2.12	2.01	2.02	1.90	1.63	1.39	1.18	1.17	1.14

Most participants (88.2%) began involvement in sports by age 5 and played between 1 and 2 sports per year until age seven. From ages 8 to 12, most participants were involved in at least two sports. The mean number of sports played per year reached a maximum of 2.12 at age 10 and began to decrease during the remaining ages. A qualitative analysis of the data showed that an increasing percentage of participants began to specialize in baseball during the specialization years at ages 13 (33.3%), 14 (45.1%), and 15 (59.1%). In the investment years, participants had committed almost entirely to baseball at ages 16 (81.8%) and 17 (83.3%).

Involvement in baseball. Table F.2 displays the frequency of players who began playing baseball at specific ages. The percentage of participants beginning baseball by age 5 was 82.4%. All participants had started baseball by age 10. Means for the number of

baseball teams played for at each age were calculated and are present in table 3. Most participants began playing for more than one baseball team per year at age 10. Figure F.1 illustrates a large increase in the percentage of players participating on at least two baseball teams per year from 21.2% to 47.1% between the ages of eight and nine. By ages 13 and 14 more than 80% of participants were participating on multiple baseball teams in a given year.

Table F.2

Age began playing baseball

Age	3	4	5	6	7	8	9	10
Freq	3	6	33	3	0	2	1	3

Table F.3

Average number of baseball teams per year

5	6	7	8	9	10	11	12	13	14	15	16	17	18
.92	.98	1.06	1.16	1.45	1.61	1.73	1.78	1.98	2	1.95	1.94	2	2.29

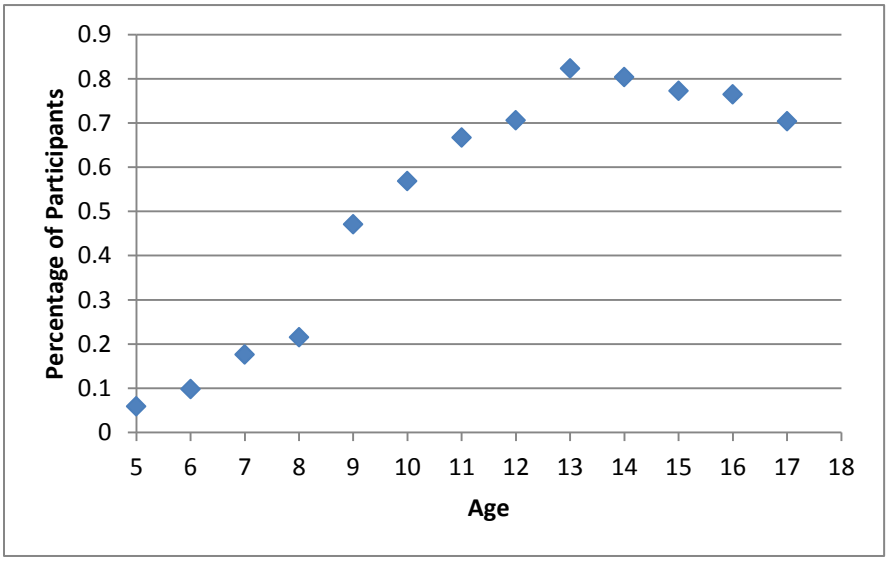

Figure F.1. Percentage of players playing for at least two baseball teams per year

Practice of baseball

Dependent variables related to practice. In the interview, participants were asked to fill out charts related to their practice history. Separate charts were completed to obtain information related to practice during the primary season, off-season, and individual practice of baseball. Participants were asked to record the numbers of weeks of practice, practices per week, and length of practice sessions at each age. To determine the number of practice hours for each age, the total number of practices at a given age (number of weeks of practice multiplied by the number of practices per week) was multiplied by the length of the practice session. This procedure was used to calculate the total practice hours at each age for the primary season, off-season, and individual practice. The total number of practice hours at each age was summed (ages 5-14) to obtain a total number of practice hours for the primary season, off-season, and individual practice for all players. The total accumulated number of practice hours in baseball was calculated by summing the number of practice hours from the primary season, off-season, and individual practice.

Participants were also asked to estimate the percentage of each practice that was committed to defense, offense, and pitching during the primary season and off-season. The total number of practice hours at each age was multiplied by the percentage of time devoted to defense, offense and pitching to obtain an estimated number of practice hours for defense, offense and pitching within each season (primary and off-season). To calculate the total hours devoted to offense, defense and pitching by age, the estimated number of hours for defense, offense and pitching within each season (primary and off-season) were summed.

Hours of practice during the primary season, off-season and individual practice

Figures F.3, F.4, and F.5 display the number of practice hours by age during the primary season, off-season and individual practice respectively. Overall participants practice more when competing for their primary season teams. During the primary season, the number of hours of practice per age increases gradually between the ages of five and 15. However, there is a plateau between the ages of 15 and 18 where the number of hours does not fluctuate by more than 10 hours. This suggests that the number of hours committed to practice during the primary season remains consistent (approximately 228 -239 hours per year) during the high school years.

Participants spend much less time practicing during the off-season when compared to their primary seasons. Figure F.4 illustrates very little practice time committed to off-season teams between the ages of 5 and 8. By age 10, approximately 80% of participants were playing for off-season baseball teams and practicing 52.80 hours. Increases in off-season practice time between the ages of 10 and 16 are small. At age 16 the mean off-season practice time was 95.21.

Figure F.4 illustrates the most significant increase in the number of individual practice hours occurs between the ages of 9 and 10. This is consistent with previously reported data related to when players begin playing for multiple baseball teams (by age 10). At age 10 players are committing more hours to individual practice (M=94.36) compared to their primary (M=87.78) and off-seasons (M=52.80). The number of individual practice hours peaks at 159.38 hours per year at age 15. This is also consistent with the maximum total practice hours by age 15 (figure F.2) (M=470.94) estimated by

participants. Figures F.2, F.3, F.4, and F.5 illustrate very few changes in the amount of time committed to practice between the ages of 15 and 18.

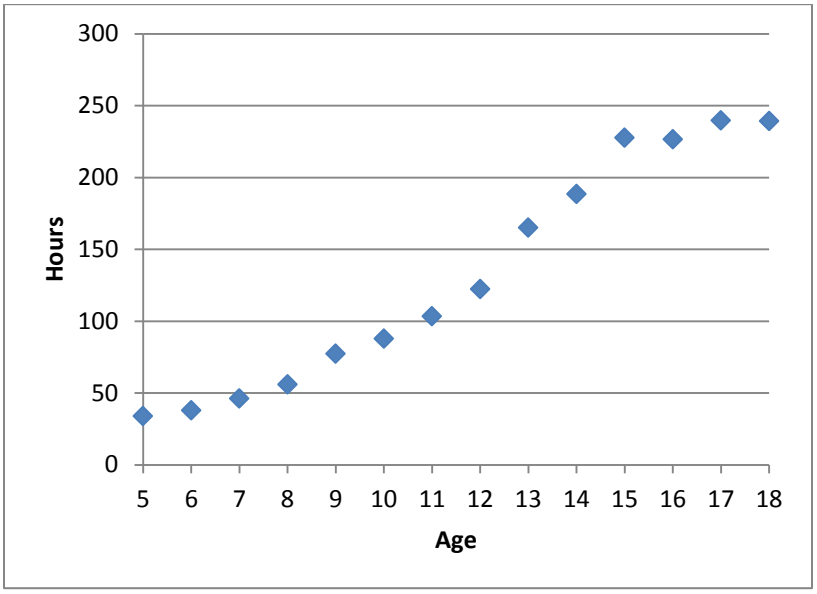

Figure F.2. Primary season practice hours by age

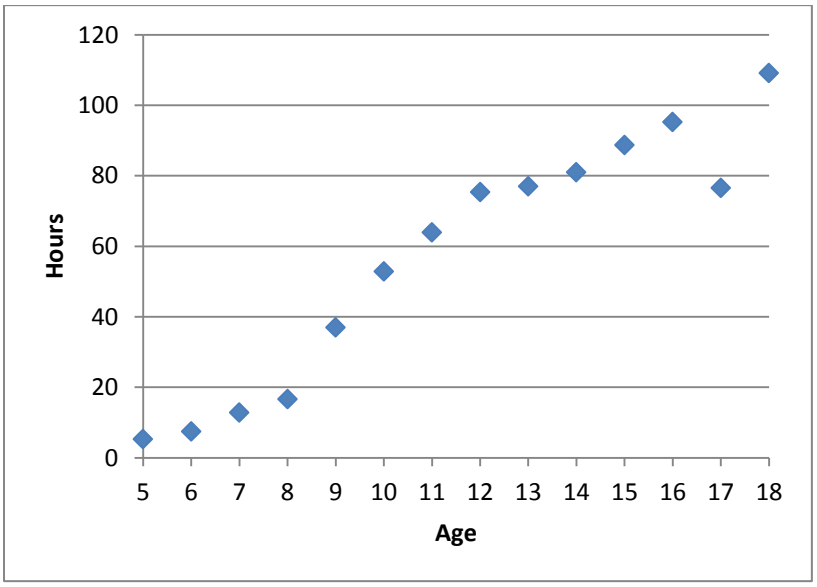

Figure F.3 Off-season practice hours by age

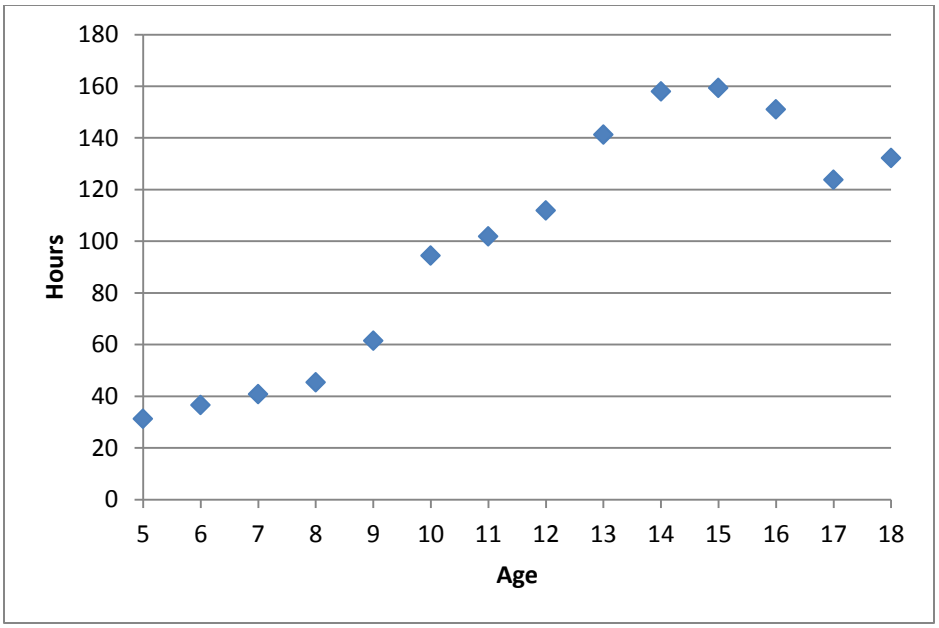

Figure F.4 Individual practice hours by age

Number of baseball games

Dependent variables related to games. In the interview, participants were asked to fill out separate charts related to their primary season and off-season practice schedules. Participants were asked to record the start and end of the season and the number of games played per week. To determine the number of games for each age, the number of games was multiplied by the length of the season in weeks. This procedure was used to calculate the total games played at each age for the primary season and off-season. To determine the total number of games played at each age, the number of games played during the primary and off-season were summed. The total accumulated number of games played was calculated by summing the number of games played (ages 5-18) during the primary and off-season.

Total games played

Table F.4 presents the means and standard deviations for total games played, primary season games played and off-season games played.

Table F.4

Means and standard deviations for total games played, primary and off-season games

	Ages 5-14 (N=51)	Ages 5-15 (N=44)	Ages 5-16 (N=34)	Ages 5-17 (N=27)	Ages 5-18 (N=11)
Total	816.71 (SD=382.51)	844.64 (SD=394.98)	868.56 (SD=433.28)	960.30 (SD=440.79)	1,025.09 (SD=247.88)
Primary Season	473.86 (SD=238.02)	466.23 (SD=244.04)	504.26 (SD=256.69	547.71 (SD=253.67	563.64 (SD=195.73)
Off-Season	386.82 (SD=241.02)	395.50 (SD=254.37)	386.41 (SD=273.46)	436.74 (SD=266.76)	495.60 (SD=132.08)

Between the ages of five and 14, the mean number of games for all participants was 816.71. Higher mean values were calculated for total primary season games played compared to off-season games. This is not surprising considering 82.4% of participants began playing baseball for one team by age five. It was not until age 10 that 80% of players were competing for off-season teams. Figure 2.2 displays the total number of games played across age. Between the ages of five and eight, the mean number of games played ranged between 19.76 (age 5) and 34.55 (age 8). By age nine, when the percentage of players participating on at least two teams increased from 21.2% to 47.1%, total games played per year increased from 34.55 to 60.35. At age 12, the mean number of total games played at a given age reached a maximum of 96.59. The mean value at age 13 was also very similar (95.76). Throughout the high school years (ages 14-18), the mean number of games played remained consistent, ranging between 86.67 and 91.03. This pattern is similar to the one found for total practice hours and suggests a ceiling may exist for the amount of time invested in practice and the number of games played in a

given year. More specifically, between the ages of 15 and 18, participants are practicing approximately 450 hours per year and playing approximately 88 games per year.

Games played during the primary and off-season by age

Figures F.5 and F.6 present the mean number of games played by age during the primary and off-season. The number of games played during the primary season gradually increased between the ages of five and 12 with the most significant increase occurring between the ages of eight and nine. A different pattern is illustrated for games played during the off-season. More specifically, very few off-season games were being played before nine years of age. Between the ages of eight and nine, the number of off-season games increased from 9.49 to 26.98. It is important to mention that the 47.1% of participants who were playing during the off-season at age nine averaged playing 49.12 games that year. By age 10, the 80% playing during the off-season averaged 52.11 games. The highest mean number of off-season games (53.76) was reported at age 13 just before players entered high school. During the high school years the mean number of off-season games fluctuated between 40 and 56 games while the mean number of primary season games was less variable (44.77 to 48.8). Due to state regulations on the number of high school games allowed per season, it is understandable that the number of primary season games during the high school years would remain constant.

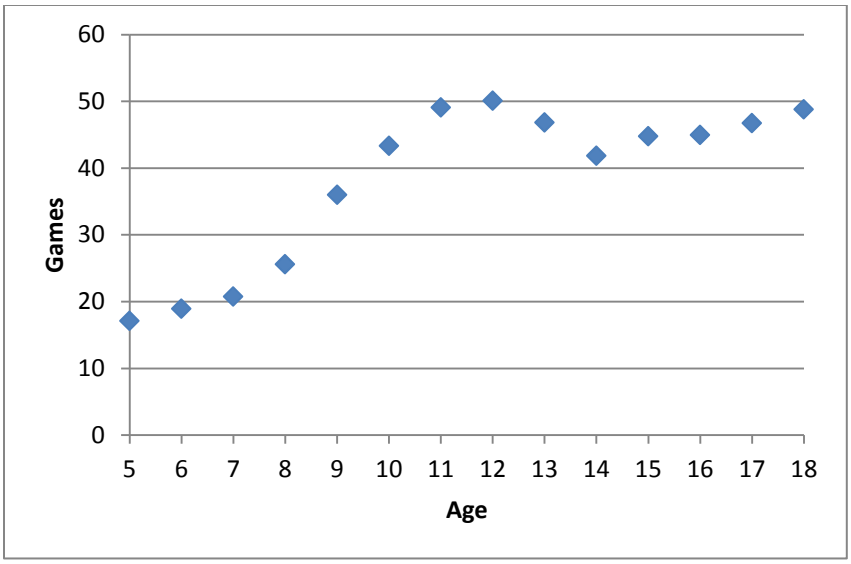

Figure F.5 Primary season games played across age

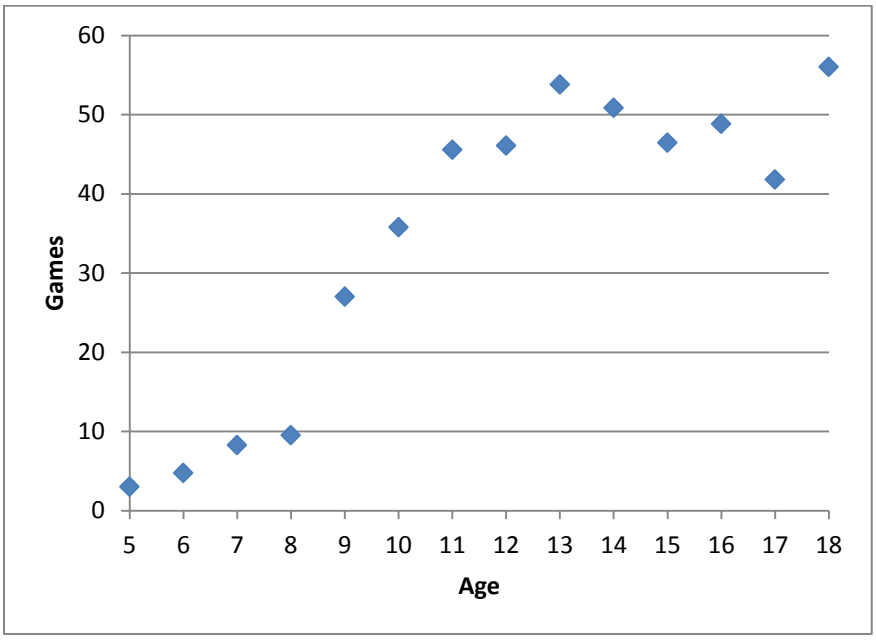

Figure F.6 Off-season games played by age

Hours of practicing offense and defense across age

Dependent variables related to hours practicing offense and defense When completing the primary season and off-season practice charts participants also estimated the amount of time (hours/minutes) they practiced offense and defense. The total number

of practice hours for each phase of the game (offense and defense) was summed (ages 5 to 18) to obtain a total number of practice hours for each phase (offense and defense) for the primary season and off-season.

Hours of practicing offense and defense during the primary and off-season across age

Similar patterns across age are noticeable for the total practice hours devoted to offense and defense. At any age mean practice hours of offense and defense never differed by more than 6.6 hours (age 15). Practice hours devoted to defense and offense increase until age 15 when they reach 143.86 hours/year and 124.49 hours/year respectively (see figures F.7 and F.8). Between the ages of 15 and 18, the amount of time spent practicing offense and defense remains relatively consistent.

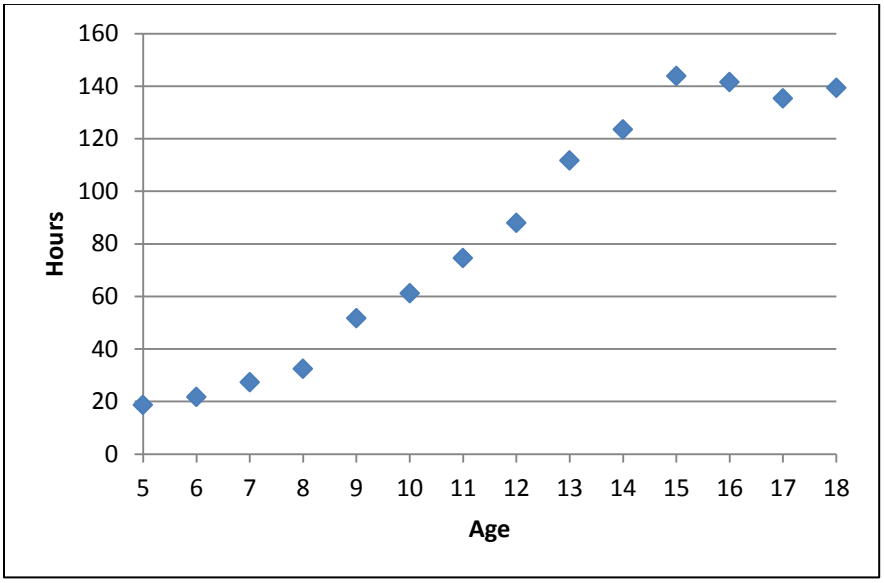

Figure F.7 Defensive practice hours by age

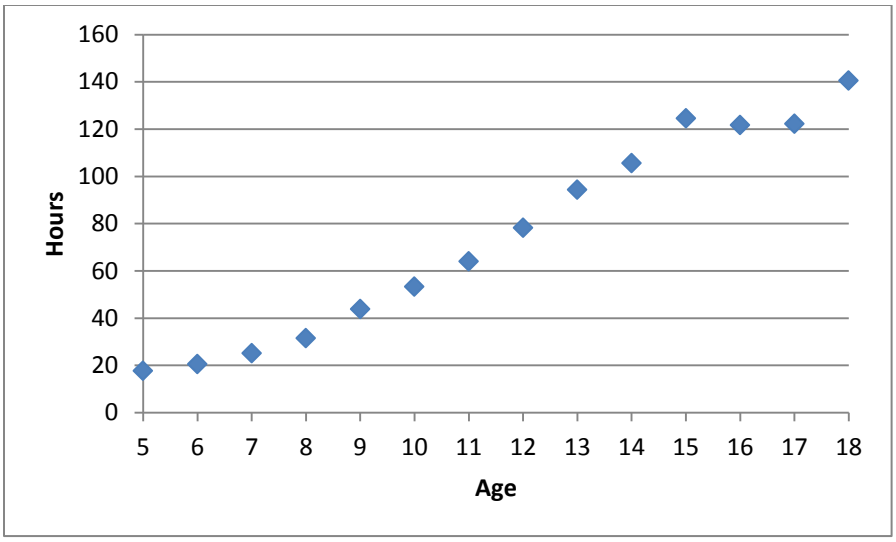

Figure F.8 Offensive practice hours by age

Hours spent practicing offense and defense during the primary and off-seasons

Figure F.9 and F.10 present the mean offensive practice hours for the primary and off-season. Overall, similar to the trend illustrated by overall practice hours during the primary and off season (see figures F.3 and F.4), participants spend more time practicing offense and defense during their primary seasons compared to their off-seasons.

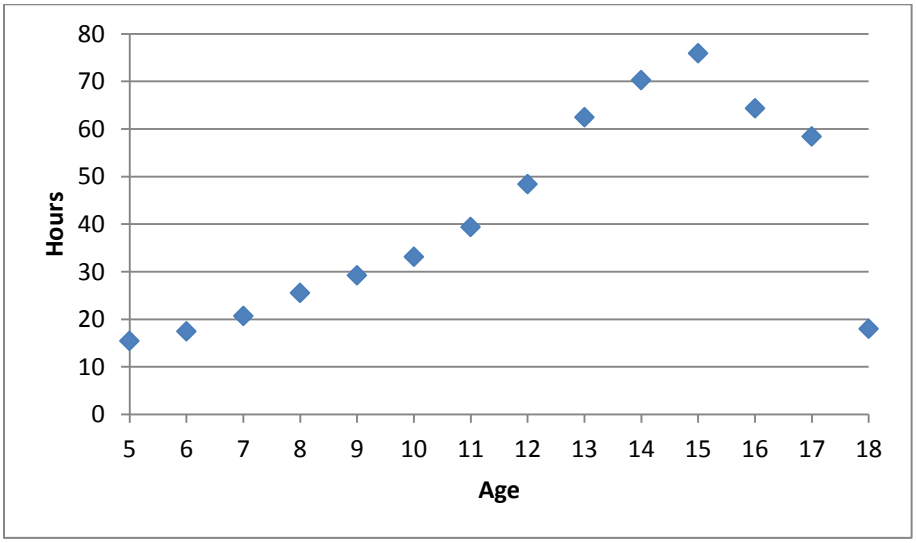

Figure F.9 Primary season offensive practice hours by age

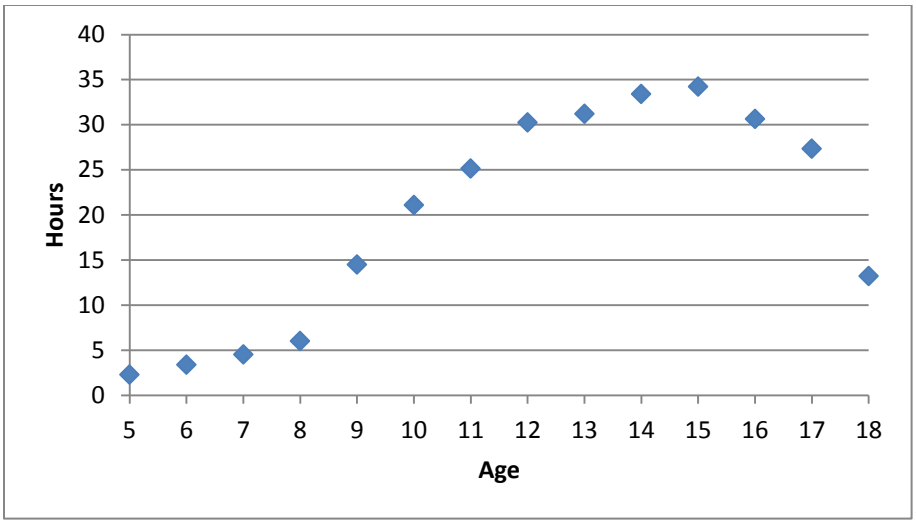

Figure F.10 Off-season offensive practice hours by age

Figures F.11 and F.12 present the mean defensive practice hours for the primary and off-season. At age 14, when more than 80% of participants were competing on multiple baseball teams each year, the mean number of defensive practice hours during the primary season (M=85.83) was much higher compared to defensive hours during the off-season (M=35.58). The number of defensive practice hours during the off-season never reaches 40. In contrast, the number of hours spent practicing defense during the primary season reaches 40 by age 10 and peaks at almost 90 by age 15.

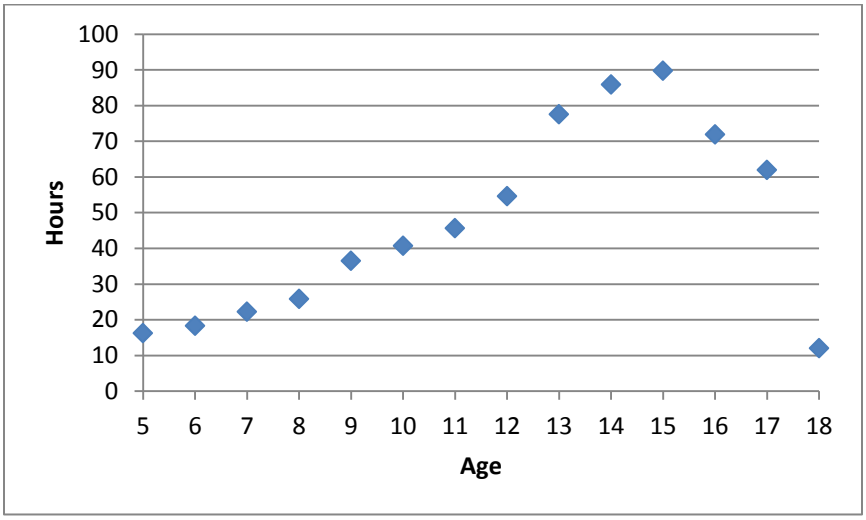

Figure F.11 Defensive practice hours during the primary season

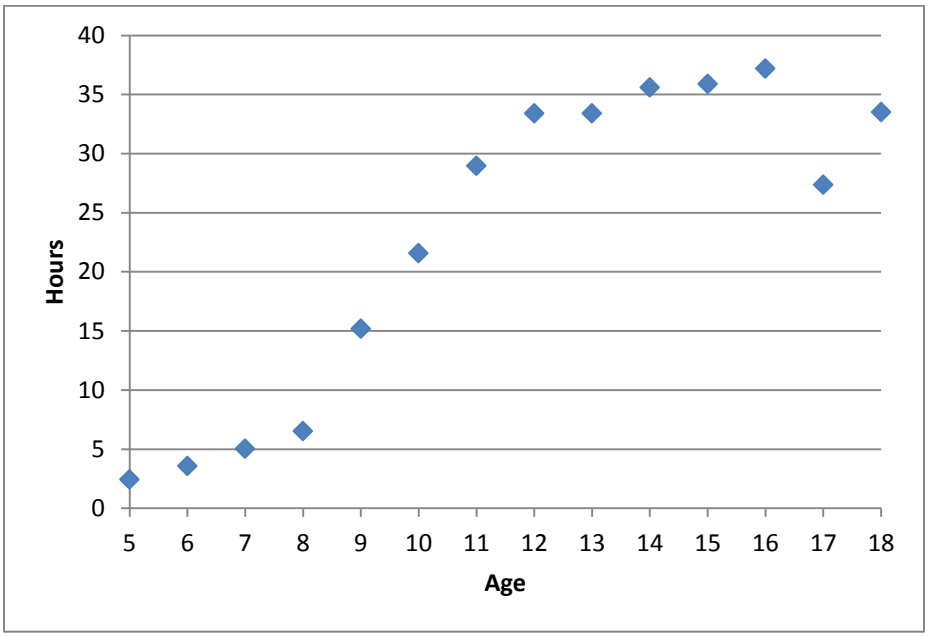

Figure 12 Defensive practice hours during the off-season

APPENDIX G: CODES FOR PLAYER INTERVIEWS (JOURNAL ARTICLE TWO)

Situation 1: Runner on first, no outs

Bold and underlined statements are major action sequences that should be taken as an individual or a team. The bold statements listed under the bold/underlined are subcategories of actions under the bold/underlined statements. Statements listed under categories or subcategories and verbalizations by given participants that were related to that particular category or subcategory. All statements are listed separately for each player position, i.e., pitchers, catchers, first basemen, second basemen, shortstops, and third basemen.

Pitchers

Bunt

If there is a bunt or something like that, I field which side I need to field and make a throw over to first (site 1 senior pitcher)

Controlling the run game

Pick off

….. some pick moves (site 1 junior pitcher)

If he's a good runner, throw over (site 1 junior pitcher)

If he's off the bag too far, see if I can pick him off (Site 3 senior)

I would check the runner and hold him, make sure he is not got too big of a lead. (site 1 senior pitcher)

The first thing is seeing his lead coming off the bag, if it is big or not.(site 3 junior pitcher)

Mix up timing of pitches

If we think he's going to steal, we'll normally do some king of timing stuff, I might hold it for 3 seconds, I might come set then go (site 1 junior pitcher)

Mix up any timing so that he can't get a good jump if he wants to steal (site 3 senior)

Slide step

Mix in slide step to mess up his timing as well (site 3 senior)

Pitch Execution

General

Execute the pitch that was called to the best of my abilities (site 3 senior)

Make a pitch (site 1 senior pitcher)

get a ground ball

We're looking for a ground ball (site 1 junior)

Focus on throwing low, try to turn two (site 1 junior)

Get a groundball, try to turn a double play (site 3 senior)

If it is not a big lead, my main focus is getting a ball down in the zone to make him hit a groundball, preferably a two-seam that will run and sink so it gets him to roll over and hit to an infielder to hopefully get a double play (site 3 junior pitcher)

Cover first base

If there is a ball hit to first base, I make sure to go on my banana path and break it down, catch the ball (site 1 senior pitcher)

Check to make sure runner at first does not go to third

Check at third to make sure the runner at first doesn't go to third (site 1 senior pitcher)

Double Play

Communicate with the SS that if I get a ball hit to me, I am going to turn glove side and throw it over the bag for the shortstop (site 3 senior)

If it's hit back to me, clear the mound, throw it to second base and try to turn a double play (site 1 senior pitcher)

Backup

Ball hit to the outfield, back up third base (site 1 junior)

Cutoff

Tandem

Catchers

Signs

I usually get a sign from coach – pitches (siet 3 junior catcher)

Then I will give the sign to the pitcher for the pitch and then he will pitch (site 3 junior catcher)

Bunt

Cover the bunt (site 1 senior)

Hold the runner at first

Check runner's lead

Check his lead (site1 senior)

See if he is going to steal (site 1 senior)

Pick off

Check secondary lead for possible pick off (Site 1 senior)

Then I will check out the runner and if he has a big lead or something, maybe flash a quick pick (site 3 junior catcher)

I will look to see if he's got a backside throw or something, I will look for it.(site 3 junior catcher)

Tandem or concern for batter/runner advancing

Watch runner round base to see how hard he rounds it (site 1 senior)

Current event –

monitor past hitter, past runners throughout game, if you watch him and it's the fourth inning, 70% of time they steal (site 1 senior)

Communication with team

I will just get it back to the pitcher and relay the outs and stuff (site 3 junior catcher)

Depending on where the ball is hit, if it's a double play yell 222, if it's a tandem yell tandem 4 (site 3 junior catcher)

First Baseman

Bunt

Look for a bunt if he's really fast or depending on who's up (site 3 sophomore)

It depends on what king of batter he is, is he a speed guy or more of a 3-4 hitter. What their tendency is. (Site 3 sophomore)

If it's a lefty, I am more alert when I am holding him on to get off the bag. (site 3 sophomore)

Bunt, stay back covering first base (site 3 junior)

Controlling the run game

General

I need to be holding him on and tell the pitcher if he steals (site 3 sophomore)

I am going to hold the runner on. (site 1 junior first basemen)

I am going to get right where I need to be and then I need to look and see based on the pitcher's, we have drilled enough so I know sort of how the pitcher's going to move his body, if he is going to pick or not,helps me get a good jump off the bag. (site 2 junior 1B)

Double Play

Ground ball, turn 2 (site 3 junior)

I am looking for a double play if there is a ground ball. (site 3 sophomore first basemen)

I want to make sure I am in a position to be able to turn a double play, het the lead out) (site 1 junior first basemen)

If it is hit to my backside, if I get the ball to make a spin and shuffle my feet, get rid of it to second and get back to the bag to field the throw (to first) (site 2 junior 1B)

Don't want to give up runs, make errors

Don't want to give up runs, you don't want to make any error there (site 1 junior first basemen)

Cover bag

Fly ball, cover first doubling him back up if he came off the bag (site 3 junior)

If it's (fly ball) to someone else just get to the bag in case, the runner's not going back (site 2 junior 1B)

Fly ball

If there is a ball in the air, if it's to me, catch it (Site 2 junior 1B)

Backup

Cutoff

Tandem

Tandem routes, move in front of home plate and be the cutoff man (site 3 Junior)

If there's a deep hit, tandem I need to cover and be the cut in case he's going home (site 3 sophomore)

Second base

Bunt

If it is a bunt situation you have to make sure you back up first base. (site 3 senior secondbasemen)

Double Play

Positioning

Take a couple of steps in and over to second base for a double play (site freshman)

Definitely shading the inside a little bit thinking about a possible double play. (site 3 senior second basemen)

Executing

Hit to my backside, flip it (site 1 freshman)

If it's hit right at me, shuffle pass (site 1 freshman)

If it's hit to my left, depends on how far away it is because if it's too far I have to go to first (site 1 freshman)

Backup

Cutoff

Tandem

If it's a ball hit to the gaps, we are going to have a tandem so the outfielders are going to turn their backs and run and get rid of the ball as fast as they can and both the second basemen and shortstop have to line up with third base in order to get the ball in (site 3 senior second basemen)

Third Basemen

Bunt

Positioning

In field in, bunt coverage (site 2 junior)

Depending on hitter, move into either the cut or even with the base (site 2 junior)

I am already playing in. So, I am basically already covering the bunt (site 1 senior 3B)

I have to know what bunt coverage there is (site 1 senior 3B)

Predictions

I'll know if they're going to bunt and even by the team, if they are down in situation, if we're up by a run, late in the game, they're probably going to try to bunt them over and into scoring position (site 2 junior)

Seeing if the guy's a bunt guy (site 1 senior 3B)

Executions/Actions

Bunt, listen to the guy saying one, two or what to do with the ball (site 2 junior)

Slow roller, know whether to throw to second or first (site junior)

Bunt, throw to first (site 3 freshman)

Hard bunt, throw to second (site 3 freshman)

Controlling run game Pickoffs

And see if there are any picks (site 1 senior 3B)

Double Play

Executing

Hit hard at me, go to second and try to roll two (site 2 junior)

I am thinking double play the whole time 9site 1 senior 3B)

Throw to first/second

Groundball that is bobbled, throw to first (site 3 freshman)

Hard ground ball, throw it to second (site 3 freshman)

Slow ground ball, check the runner and throw it hard to second (site 3 freshman

Pop up

Popup, catch it and check runner (site 3 freshman)

Backup

Fly ball to RF, move closer to second base or behind second base to back him up (site 2 junior)

Fly ball, move closer to pitcher (site 2 junior)

Cover third base

Ground ball right side, if it gets through, they're going to try to come to third so I'll be moving to the base (site 2 junior)

Pitcher fields it, get back to third knowing they're going to try to come to third if I'm not there (site 2 junior) *****need context for this one – is this after the ball gets through on right side, see above statement

Cutoff

Tandem

Short stop

Bunt

Bunt, cover second, (site 1 sophomore)

I will tell first base or third base that he has got the line on a bunt (site 3 senior shortstop)

And pitcher's got first base side (site 3 senior shortstop)

Controlling the run game

Steal

Tell second baseman who's got the ball if he steals the bag depending on who's up to bat (site 2 junior)

First thing I am going to do is communicate with my 2b regarding who has the bag coverage (site 3 senior shortstop)

With a lefty up I will usually take the bag and a righty, second basemen will take the bag (site 3 senior shortstop)

I am keeping him in the eye, my peripheral vision in case he steals (site 2 sophomore middle infielder)

Even though first base is supposed to yell he's going, I always yell if he's going at short and second (site 2 middle infielder)

So I either need to cover the bag or get behind him(site 2 sophomore middle infielder)

Postioning of outfield based on batter

I will communicate to my outfielders what kind of hitter it is – power hitter maybe back up a few steps (site 3 senior shortstop)

Little lefty slap hitter bring left fielder in a little bit cause he is not gonna hit it over his head (site 3 senior shortstop)

Double Play

Positioning

Move to double play depth (site 2 junior)

First thing I will do when he gets on first is I will probably scoot in two and over a couple of steps for good double play depth and just be ready for a groundball (site 3 senior shortstop)

At second or short, I am moving closer to second base getting into double play positioning (site 2 sophomore middle infielder)

Executing

Ball hit to arm side, double play or throw to first (site 1 sophomore)

Ball hit to right him or armside towards second, turn two (site 1 sophomore)

If the ball's hit to me, I am turning it with the second basemen (site 2 junior)

If the ball's hit to second or first base, I am turning it with them and we are trying to get two outs out of it (site 2 junior)

If it's hit to me I will obviously turn two (site 3 senior shortstop)

If it's hit to second base, I will cover second (site 3 senior shortstop)

If it's hit to first, I will cover second (site 3 senior shortstop)

……(hit to) pitcher or catcher, I will cover second (site 3 senior shortstop)

If it's hit to me at second or short, I am going to throw to short depending on where it is, behind second base, I will probably flip it (site 2 sophomore middle infielder)

If it hit right to me, I will probably flip it back hand (site 2 sophomore middle infielder)

If (he does not steal) I will probably make a quick throw to second (site 2 sophomore middle infielder)

Communication who has bag on DP

Tell pitcher who has the bag if the ball's hit back to him (site 2 junior)

Then I will communicate to my pitcher that I got him on a comebacker so we can turn a double play (site 3 senior shortstop)

Throw to first if he steals

If he steals, I am obviously just going to throw to first (site 2 sophomore middle infielder) (Does not have time for double play)

Backup

If it's hit to third, I will back him up (site 3 senior shortstop)

Cutoff

Ball hit to outfield, cutoff man to third (site 1 sophomore)

If it swings through, I will swing around to be cutoff for left fielder (site 3 senior shortstop)

If it's hit to the right side in the outfield, I will go to second to just be there and I will line up the second basemen for cutoff (site 3 senior shortstop)

If it goes into left or left center, I will be the cutoff (site 3 senior shortstop)

Tandem

Current event profile

Monitor past hitter, past runners throughout game, if you watch him and it's the fourth inning, 70% of the time they steal (site 1 senior catcher)

Situation 2, Runner on second, one out

Pitcher

Bunt

Looking for whatever the bunt coverage is, depending on how it is called I may be covering third base line. (site 3 senior pitcher)

Probably, in our normal coverage, be communicating with the third basemen that I will cover his line. (site 3 senior pitcher)

If it's hit hard, I'll check third base, but most likely I will be going to first. (Site 3 Senior pitcher)

If there is a bunt I usually get the third base side (site 1 senior pitcher)

If that runner running to third the third basemen's going to stay there and I can cover the third base side (site 1 senior pitcher)

Execute the pitch

General

First, once again, execute the pitch (Site 3 Senior pitcher)

Get ground ball

In this situation, I am trying to get a groundball as well. (stre 3 senior pitcher)

We really don't want something to the outfield, we want to keep it on the infield, so you are trying to get him to roll over something especially with one out. (site 1 junior pitcher)

Pitch him – pitching low and try to hit our spots (site 1 junior pitcher)

Force to hit to right side

You are trying your best for him not to move the ball to the right side. So probably preferably you would pitch inside so if he does try to get it opposite field it going to be weak, he might pop it up or something. (site 3 junior pitcher)

I would probably pitch him inside and ten changeups – get him out in front so he hits a ball to third base or shortstop (Site 3 junior pitcher)

When that ball is hit (right side) there he can't really advance so he has to stay at the bag so there would be two outs and a runner on second (site 3 junior pitcher)

Controlling the run game

Pickoffs

I thinking look for pickoffs signs from short stop or second basemen for picks (Site 3 Senior pitcher)

We'll do some inside moves if we think he is getting a big lead, or different timing picks to second base – try to hold him close. (site 1 junior pitcher)

So you have to wait for (runner) to get a lead, if he's got a big lead, pick him off (site 3 junior pitcher)

Mix up timing

Mix up timing (site 3 senior pitcher)

Mix up looks

and mix up looks to second base (site 3 senior pitcher)

we do a lot of different looks towards second base to keep him close (site 1 junior pitcher)

Short stop and second to cover bag

Short stop and second baseman are coming in to try to keep him close to the bag (site 1 junior pitcher)

Check runner, throw first

Bunt, if it is hard enough, I will look third but most likely I will just go to first. (site 3 senior pitcher)

Get the ball and possibly make a throw to third and then make a throw to first if I can't get there. (site 1 senior pitcher)

If there is a groundball to me, I will check the runner and then go to first (site 1 senior pitcher)

Backup

Fly ball to the outfield, I am going to back up third (site 3 Senior pitcher)

Ground ball to the outfield, I am backing up home (site 3 senior pitcher)

After the ball's hit, with a guy on second, I am backing up home (site 1 junior pitcher)

General fielding/communication

So if it's a ground ball, I will stay on the mound and I will look and whatever, I am watching the runner so I can let my infielders know where to go with the ball (site 1 junior pitcher)

Catcher

Stealing signs

Look at him, make sure he's not stealing my signs that I am giving the pitcher (site 1 catcher) You find little tricks doing that – you find him if he's flashing his hands or looking in certain directions, you catch him doing that (site 1 senior catcher)

Get a sign again (site 3 junior catcher)

We have a touch system where we go chest touches and then depending on how many touches we get. If we give three touches, It would be the third sig we give to the pitcher(site 3 junior catcher)

Prediction of runner

If he is an aggressive runner, if it's shallow ball hit to the outfield, he'll probably try to take home, but if he's not real aggressive then I have a look and ease off him a little bit (site 1 senior catcher)

If it's a slow ground ball hit in the outfield and he's taking that big turn around third you definitely know he's coming home, then relay where to throw the ball. (site 1 senior catcher)

Pop fly

If it's a pop fly and he hasn't tagged up on second, I would shout out in the field , throw it to second.(site 2 senior catcher)

Bunt

Contolling the run game

Pickoffs

We have verbal communication between the middle infield and catcher depending on if we have a pick so I will look for that (site 3 junior catcher)

The pitcher also has verbal communication like if he wants to quick pitch to the second basemen (site 3 junior catcher)

General fielding/communication

Depending on where it's hit and what the situation it call it and make the right call (site 3 junior catcher)

I am thinking where do I need to be , where do I need to tell people to be, line people up. Get them in the right position to be backing up (Site 3 junior catcher)

Third Basemen

Bunt

And then bunts, stay – it matters what the play is. (site 3 freshman 3B)

Not really worried about the bunt coverage right there cause I am always staying (at third) (site 1 senior 3B)

Coverage

So we gotta get in a bunt coverage. Usually it's a roll three. (site 2 junior third basemen)

Fielding

I am going to read and react (site 2 junior third basemen)

If it's hard past the pitcher, I gotta get the ball. (site 2 junior third basemen)

Usually, pitcher has priority on it. So they will get it and I will come back to third. (site 2 junior 3B)

Look runner back at second base, throw to first

If I get the ball, check the runner, make sure he's not going anywhere, then throw it, quick throw to first (participant 1 freshman third basemen)

If I get the ball, look him back, go one (site 1 senior 3B)

Cover third base

If the ball's hit to short, make sure I get back on the bag.If the runner goes, run him back and try to get him out. (participant 1 freshman third basemen)

Ball hit to the outfield that is in the gap, we are going four so I will stay at third (site 1 senior 3B)

If it's in the gap and the guy babbles it, it is coming to me so I gotta be there (site 1 senior 3B)

Backup

Cutoff

If it's hit backside, I gotta know, or if it's hit backside you have to try and think they're going to score, I usually get towards the cut to try and hope the guy doesn't try to cut a base and get through. (site 3 junior third basemen).

If it's hit to the left side, I am going to cut off to home, so I gotta know my fielder. I have to know his arm strength. I have to know where I have to be. (site 3 junior third basemen)

First Basemen

Bunt

On a bunt, I am charging coming forward (site 3 junior first basemen)

Be looking for a bunt and in this bunt coverage, I need to be charging so the third basemen stays back since they are trying to move him over, especially with one out. (site 3 sophomore first basemen)

Positioning

I am going to be playing normal depth because a bunt's probably not going to happen here because it's not that beneficial to get a runner on third with two outs cause runner on second and third with two outs is about the same thing. (site 2 junior first basemen)

They might be trying to hit it to my side of the field if they want to move him over. I may just play a little deeper, I mean if it's not obvious the guy's going to bunt, 2 strikes or so. (site 3 sophomore first basemen)

Check the out at first check runner to see if play at third

Ground ball hit to me, I am going to get the out at first, check him at third. (site 3 junior first basemen)

Ground ball anywhere else, check the runner, if he is going throw him out at third (site 3 junior first basemen)

*** Series of if thens

*** If ball's hit hard at me, just check the runner to see if he didn't get a good jump I could throw it over there (site 2 junior first basemen)

*** If the ball' hit to me, just get to the bag, touch it and then look at the runner to see if I could throw behind (site 2 junior first basemen)

*** If it hit to another fielder just to catch the ball and be ready to throw it behind. (site 2 junior first basemen)

If there's a groundball, I need to check him and get him out at third and get the guy at first (site 3 sophomore first basemen)

Double play

If there's line drive to me, a double play (site 3 sophomore first basemen)

Backup

Cutoff

He's going to be going on contact, so if the ball's hit on the ground to center fielder or right fielder I know I have to be the cutoff man at home. (site 2 junior first basemen)

Anything hit to the outfield from center to right side I will be the cutoff man – left side's third basemen (site 3 junior first basemen)

If it's a groundball to center or right field, I am going to be cutting to home so you don't want him to be able to score (site 3 sophomore first basemen)

I want to make sure that I get where I need to get on a cutoff. Centerfielder, right fielder. Make that cutoff, don't want that run to score. You definitely don't want the run to score. You don't want to be that guy that is not where he needs to be where he is supposed to be because you kind of let everybody else down. That is the thought process there in my head. (site 1 junior 1B)

Tandem

Anything hit to the gap, such as a tandem, I will be covering second base, being the trail runner (site 3 junior first basemen)

General fielding/communication

Short stop

Bunt

I will tell out third basemen, usually he is staying back on a bunt, so I will tell him that pitcher has his line and first has their line. (site 3 senior shortstop)

Controlling the run game

General Team

I am going to hold, what we do as a team, we will hold the runner, keep him as near, close to 2B as we can. (site 2 junior short stop)

First thing, I will do is communicate to my second basemen who is holding him on. Usually how we do it is I hold him on, just to make it, that is how we run all our plays (site 3 senior shortstop)

Pitcher looks

That's based on pitcher's head looks and we will kind of determine that as a team. (site 2 junior short stop)

Pickoffs

I am going to check my coach for any pick off moves. Talk to shortstop – who's got the bag on the pick and everything (site 2 sophomore middle infielder)

Steal

If he's going I am going to yell go obviously. Steal (site 2 middle infielder)

Short stop and second to cover bag

I am going to bounce in and out of covering the bag. (site 2 sophomore middle infielder)

Check runner, throw to first

When the ball is hit, I will check him and if he's going I will throw it to third, but there's really no play, I will just go to first (site 3 senior shortstop)

If it's hit behind him, I will still field it and I will just go to first cause I won't get him at third (site 3 senior shortstop)

If the ball's hit to me, I am going to look at the second basemen, I mean the runner on second, and probably make the play at first most of the time. (site 2 junior short stop)

If it's hit to me at shortstop, I am going to check him and but if he's stealing, I am just going to go to first. (site 1 sophomore short stop)

***Series of specific if-thens

*** If the ball is hit right at me, I am going to look at him, and if he's far enough obviously my second basemen will be there and he will be calling for two, saying two, two, two. I will throw it behind him and we will get him out. (site 1 sophomore short stop)

*** But if not, I will just field the ball, look him back and go one with it. (site 1 sophomore short stop)

*** And then if it's over here, and he goes hopefully my third basemen will be talking to me and I will throw in from of him and get him out. (site 1 sophomore short stop)

*** And if it's this way (towards second), I will probably end up going one with it since it's going this way. (site 1 sophomore short stop)

Backup

If it's hit back to the pitcher, (Playing second base)at second, I would go back up first (site 2 middle infielder)

Then (playing SS), I would just kind of stick at the bag and watch for the throw behind third. (site 2 middle infielder)

Cutoff

If it is hit right here, if it's hit to left field and I gotta make sure my left fielder fields it clean, then I gotta go to third. (site 1 sophomore short stop)

If it goes through towards the left side, I will cover third case the third basemen is getting the cut from the left fielder. (site 3 senior shortstop)

If it's hit to center field I will cover second and first baseman will get the cut second's going to go to first. (site 3 senior shortstop)

Tandem assume concern for trail runner

And if it's hit to center and right, I will just go to second base in case one of them bobble it and if he bobbles it he's obviously gonna score (runner from second) so I will just be there in case this runner (hitter) tries to make a double of out of it. (site 1 sophomore short stop)

If it's hit to the fence then we will double cut and we will probably end up going three with it because he's definitely going to score (runner at second) (site 1 sophomore short stop)

General fielding/communication

I will tell the outfielders what they are going to do with the ball. (site 2 junior short stop)

And if it is caught (in the outfield) I will see if he is tagging. If he is tagging I will communicate that to my outfielder (site 3 senior shortstop)

Second basemen

Bunt

Controlling the run game

Signs

We will be getting signs to see how many looks the pitcher is going to be giving. (site 1 freshman Second basemen)

Pickoffs

When we are working the runner and we will be giving signs to see if he is going to give a pickoff or not. (site 1 freshman second basemen)

We are working him so he does not get a big lead. (site 1 freshman second basemen)

Whether or not depends on what the team's preference is, but if you want to possibly have a pick off play with the second basemen that could be possible (site 3 senior 2B

Throw to first

Positioning and throw

When the pitcher is about to deliver, we break out and just see if I can field the ball next to me and throw it to first (site 2 freshman second basemen)

Just sitting my backhand, just get it and field it, throw it (site 2 freshman second basemen)

Throw to third

On a ball hit back to you, depending on how hard it is hit, you can possibly get him out at third, but your main priority is keeping the ball in the infield so he doesn't score. (site 3 senior 2B)

General goals/no specific actions

Try to keep the ball on the infield as much as you can keep the runner from scoring (site 3 senior 2B)

Situation 3 runners on first and second , no outs

Pitcher

Controlling emotions

I would say ..for me, I am trying to get my head on straight cause I just let two guys on and I still have no outs. Just really trying to focus on what I am doing, throwing strikes. (site 1 junior pitcher)

Bunt

Need to know bunt coverages, same as previous one. I am probably going to be covering the third base line. (site 3 senior pitcher)

If it's hit hard, I will check third base, but most likely I will be going to first (site 3 senior pitcher)

Depending on where the bunt is, just make the throw wherever the bunt is. That would depend on where I would throw the ball to the guy (site 1 senior pitcher)

If it's more likely to the first base side, I will pick it up cleanly and throw it to first. (site 1 senior pitcher)

Execute the pitch

Execute the pitch (site 3 senior pitcher)

Trying to get a groundball (site 3 senior pitcher)

Just make a pitch probably down in the zone, you don't want a high fly ball that will carry. Move them over two bases which would be second and third one out. (site 3 junior pitcher)

So preferably a ground ball so you get that groundball to pitch him low in the zone, get a groundball, get a possible double play or if not a double play it would be first and third with one out and you could try again next pitch to get a double play. (Site 3 junior pitcher)

Hold runners

Pickoff

Look for pickoff signs (site 3 senior pitcher)

Mix up timing and looks

I am thinking mix up my timing and my looks to keep the runners from stealing (site 1 senior pitcher)

Throw to third

If it's a fast groundball to third and I have time to pick it up and still have time to throw it to third, I can get that out there. (site 1 senior pitcher)

Double Play

Communicating with my SS, groundball hit back to me, I am throwing to you for the double play (site 3 senior pitcher)

Best case scenario is another groundball to keep them where they are at, turn two and get two outs. (site 1 junior pitcher)

If there is a groundball back to me, I would go and probably try and turn two on it. (site 1 senior pitcher)

Get a possible double play (site 3 junior pitcher)

Cover first

If the first basemen's there and he gets a groundball hit to hi,k I would probably run over there and get the bag from him. (site 1 senior pitcher)

Backup

Fly ball to the outfield I am going to back up third (site 3 senior pitcher)

Groundball to the outfield I am backing up home (site 3 senior pitcher)

Wherever the ball is hit, in the outfield, if it's a double, I am going to third cause we assume that a guy from second is going to score (site 1 junior pitcher)

But if it is straight at the outfielder, I am still going to back up home. (site 1 junior pitcher)

General goal

In this situation, you just try and get an out, specially the lead runner. You just need to get an out first of all (site 3 junior pitcher)

Second Basemen

Bunt

On a bunt, you have an L route to back up the first baseman. (site 3 senior 2B)

Controlling the run game

Pick off

Still going to be working him and looking for picks (site 1 freshman second basemen)

Double play

*** series of if then, based on location of hit in his area – that is why I put them all under DP

***** Ball hit to me, I am going to try and turn it with the shortstop. (site 1 freshman second basemen)

*** If there is a runner on just first, if it's hit too far to my left, just throw it to first (site 1 freshman second basemen)

*** If it's hit anywhere else just throw it to second and try to get the lead out. (site 1 freshman second basemen)

Definitely a double play ball if it is hit up the middle just get a quick double play. (site 3 senior 2B)

Tandem On a ball hit to the outfield, we have another tandem. That means cause it is a runner on first, and probably on this play probably going home with it and the shortstop and second basemen are going to line up. (site 3 senior 2B)

Shortstop

Bunts

Bunts, Obviously I would probably just go to second cause he's got the long one, pitcher's got to be there. (site 1 sophomore shortstop)

I will tell third ase that he's, that the pitcher has got his line cause if we are trying to get an out at third he will get it. (site 3 senior shortstop)

If it is early in the game I will tel him to get the bunt and get the out at first. (site 3 senior shortstop)

Controlling the run game

Hold the runner at second

I am going to hold the runner on second but (site 2 junior shortstop)

Steal

Depending on what the catcher wants to do with the throw down, we'll communicate whether I have the bag or the second basemen. (site 2 junior shortstop)

I will still communicate to second who has got back but usually the catcher will just throw it to third on a double steal. (site 3 senior short stop)

Positioning double play depth

when I shift back to my position, it is going to be double play depth.(site 2 junior shortstop)

at shortstop, I would probably, I would get closer obviously double play coverage, but I would stay a little bit open cause I want a little range to the six hole in case there's ia ground ball and I could toss it over to third real quick. (site 2 middle infielder)

I am going to be in double play depth again (Site 3 senior shortstop)

Double Play

Usually just try and get the double play at second (site 3 senior shortstop)

We are still probably going to turn it in the middle with the pitcher which means the SS will turn it. (site 2 junior shortstop)

If I don't have a chance in the middle, I might take the lead out at third, but most of the time we are going to try to turn the ball into a double play up the middle and get two outs out of it. (site 2 junior shortstop)

But if it's hit this way (toward second), we are going to turn two with the second basemen (site 1 sophomore shortstop)

Communicate to my pitcher. Depending on the situation, if it's early in the game we would probably to to second and first and get a double play. (site 3 senior shortstop)

Throw to second

At second base (when I play second base), I am going to flip it at second if it come to me or tag him if his back is to the ball on a short roller or something and I am going to take a look at third (site 2 middle infielder) **Not sure what he wants to do**

If I make a fielding error

If I bobble it or something, I am going to pump fake usually and check the runner at third and second – that's what is going through my head. (site 2 middle infielder)

Lead out at third

If the ball's hit deep in the hole, towards third base, if I don't have a chance in the middle, I might take the lead out at third. (site 2 junior short stop)

If it's hit right at me I am obviously going to go to third (site 1 sophomore short stop)

If it's hit to my arm side, I would go to third with it and get the lead out. (site 2 middle infielder)

I always tell the third baseman if it comes to this side, I am coming to you with it so he knows to be there because I am really mad if he's not there. (site 2 middle infielder)

If feel like late in a game, comeback to the pitcher, we would just get the out at third if it's a close game. (site 3 senior shortstop)

Maybe late game situation, like a ball in the hole, I will go to third. (site 3 senior shortstop)

Or if there is a ball in the hole and I can't go to second, I will go to third. (site 3 senior shortstop)

Cover second or third hit to outfield

If it goes through, left side, I go to third base to cover the bag (site 3 senior shortstop)

If it goes through right side in the outfield, cover second (site 3 senior shortstop)

Cutoffs

On cuts, we are probably going four with it, so if it's hit over here (left field) just make sure he fields it, and go to third. (Site 1 sophomore short stop)

Hit anywhere else, go to second (site 1 sophomore short stop)

Tandem

Double cut, we will probably end up going four with it for him…for the runner at first (site 1 sophomore short stop)

If it is a double or triple, we will run a tandem and try to get him at home, the guy at first, get him at home (site 3 senior shortstop)

First basemen

Bunt

It's going to depend on who the runners are and who the batter is, but in this situation there's more than likely, like 75% of the time they are going to bunt in high school (site 2 junior 1B) **After prompt** – If it's the first inning of the game you got runners on first and second, that is the three hole hitter, he might not bunt – he might be one of the few guys you are not going to see bunt. Running wise, if you've got a slower person on second or third, or second or first there, you have to know you have more time to make a throw there or you have more time to be perfect with you feet, you don't have to get rid of it as quickly. You don't have to try to rush things cause that's when mistakes happen a lot of the time.(site 2 junior 1B)

Or be in front of the bag and be ready if the ball ….(site 2 junior 1B)

There's a high likelihood of a bunt here to get second and third with one out so I need to be charging on a bunt. (site 3 sophomore first basemen)

Look for a bunt, if he's really fast or depending on who's up. Well it depends on what kind of batter he is, is he a speed guy or more a 3-4 batter. What their tendency is. (site 3 sophomore first basemen)

Bunt play, I am charging (site 3 junior first basemen)

Depending on the situation, like what inning we are in, how, what the score is a team might want to bunt in this situation. So, I might, if the coach gives bunt call, I will be in front of the runner on first. (site 1 junior 1 B)

If you have a 2-1 game, bottom of the 7th , runners on first and second, no outs and depending on where they are in the line up they might want to drop the bunt, move the runners over, set it up for the next hitter. You are going to make sure that you are not giving them that bunt. You want to make sure you can at least get an out there. You really don't want to give that away, you don't want to give away bases. (site 1 junior 1B)

You are not going to bunt with your third and fourth hitter, they are usually your best hitters, your RBI guys. Top of the lineup, really, they might not bunt with them because they are usually better hitters. Bottom of the line up, they more than likely to bunt because they are not as strong of hitters (site 1 junior 1B)

Holding the runner

So either be holding him on (site 2 junior 1B)

I don't need to be holding him on since he's got nowhere to go, (site 3 sophomore first basemen)

Not holding him on (site 3 junior first basemen)

Steal

but I do need to watch for a double steal and tell the pitcher about that (site 3 sophomore first basemen)

Double Play

Looking for a double play if there is a ground ball (site 3 sophomore first basemen)

Double play (site 3 sophomore first basemen)

Ball hit to me, probably going to throw to second and try and turn two there (site 3 junior first basemen)

And just be able to be ready to turn a double play if it's a ground ball hit to me. (site 2 junior 1B)

If not, I will play a little farther back and I will make sure that I can get to the bag in case there is a double play. (site 1 junior 1B)

Throw to third or second based on runner

If the bunt is bunted hard back to me to figure out if I need to throw it to third or second just based on the runner there (site 2 junior 1B)

More likely try to get the lead out at third more than likely (site 2 junior 1B)

Cutoff

If there is a ground ball/line drive to the outfield, I need to be the cut. (site 3 sophomore first basemen)

Anything hit on the ground to the outfield from center to right, I am the cutoff man (site 3 junior first basemen)

If it's hit to the outfield, like center and right again, I have to be the cut man at home. (site 3 sophomore 1B)

I want to make sure I can get to my cutoff spot to be able to make an accurate throw (site 1 junior 1B)

Tandem

Tandems, I need to be the cut for home as well since there's a guy on first. (site 3 sophomore 1B)

Tandem wise, anything hit to the gap, I will be standing in front of home plate being the cutoff man (site 3 junior first basemen)

Check where runners are

Checking the guy, and watch the guy on second to see if he's going to go home after I get the ball (site 3 sophomore first basemen)

Third basemen

Bunt

Bunt coverage – usually it matters what bunt coverage we are in. If we are in form of 3-3, up close which I am going to field the bunt, if the shortstop's covering third, see if I can get it, but if I am not, then go to first. (site 3 participant 1 freshmen 3B)

If I am playing back, let the pitcher get it and get back on base and give the pitcher an option. (site 3 participant 1 freshmen 3B)

Bunt coverages, just making sure we are not in a certain bunt coverage where I have to go in or anything. (site 1 senior 3B)

Controlling the run game

See if we have any pick moves on. (site 1 senior 3B)

Tag third

Ball hit right at me, I am going to tag the base. (site 1 senior 3B)

Tag third go to first

Tag third go one, if I get a hard short back to me. (site 3 participant 1 freshmen 3B)

Throw to second

If its playing me to the shortstop hole between short and third, get the ball and throw it to second (site 3 participant 1 freshmen 3B)

Throw it to first

Then *if I bobble it*, throw it to first (site 3 participant 1 freshmen 3B**)**

Double Play

Still in roll three. There's a double play now. Backhand I am probably going to go touch first,touch third and throw to first. (site 2 junior third basemen)

Forehand, depending on where the runner coming to third is, I might tag him, throw to first, or just roll it around the horn. (site 2 junior third basemen)

If it is hit in the gap where I go to my arm side, I mean glove side, I am definitely goin to turn two there (site 1 senior 3B)

Cutoff

If it's hit hard to left, I have to be the cut off (site 2 junior third basemen)

Ball hit to the outfield I am the cutoff man (site 1 senior 3B)

Cover third base (tandem/trail runner)

If it's hit in the gap or to the right side, I have to know that there could be a play at third (site 2 junior third basemen)

Catcher

Bunt

Bunter's ultimate opportunity. 90% of the time they are going to bunt and move the runners over. (site 1 senior catcher)

If they are going to bunt, I am going to relay where everyone has to cover, like which side and how many outs. (Site 3 junior catcher)

If we have certain bunt coverage on I will tell them that. (site 3 junior catcher)

Force play at third

Force play at third, know where the ball needs to go after it's hit. (site 1 senior catcher)

General communication

Then I will just relay where to throw the ball and where everyone is going to go. (site 3 junior catcher)