12-4-2014

Motor Control: Theory and Practical Application for the Youth Basketball Coach

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MOTOR CONTROL:
THEORY AND PRACTICAL APPLICATION FOR THE YOUTH BASKETBALL COACH

A Capstone Experience/Thesis Project

Presented in the Partial Fulfillment of the Requirements for

the Degree of Bachelor of Science with

Honors College Graduate Distinction at Western Kentucky University

By

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2014

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ABSTRACT

BACKGROUND: Motor control, learning, and development need to be considered by any coach working with youth athletes. When coaches fail to consider these areas, they may be more likely to create practice plans, which omit the innate physiological and psychological differences between youth and adult participants, lessen the development of sport-specific skills, and may create less enjoyable sporting experiences for young players. PURPOSE: The aims of this literature review were to explore recent scientific literature linking motor behavior/development to application in youth basketball, identify major themes, and summarize these concepts in a manner useful to coaches in this environment. METHODS: An extensive review of electronic databases was conducted for recent scientific literature relating motor behavior to youth sport, basketball, and teaching. Databases reviewed included Medline, CINAHL, and SportDiscus. DISCUSSION: Very few peer-reviewed articles linking motor behavior to coaching youth basketball have been published in the past decade. Nonetheless, there were numerous recent findings involving youth participants, which can be generalized to coaching young basketball players. This project summarizes these themes within motor behavior literature and links them in ways that coaches may find beneficial when teaching basketball skills to young players.

Keywords: Motor control, motor development, youth basketball, coaching

Dedicated to my parents

ACKNOWLEDGEMENTS

I would like to thank all the people who have been involved in this process and for the opportunity they have provided for me. Especially Dr. Hoover for providing me with the idea for this topic and being a very helpful advisor throughout the entire process.

I would also like to thank my family for all the support and motivation they have given me throughout college as I pursue my degree.

VITA

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CHAPTER 1

INTRODUCTION

In today's sports environment, coaches likely look for the best drills, techniques, and approaches to teach skills that can take his or her team to the next level of performance. Inexperienced youth coaches might often seek information from individuals with more experience, such as professional and college coaches. They may take drills from these coach's camps or practices and try to apply them to their own youth teams. The idea behind this strategy is a clear one: some believe that the drills used by professional and college coaches must be the best way to improve a player's performance, otherwise these high profile coaches wouldn't be using them in their own practices. Such a strategy may be problematic, as these may be appropriate drills best suited for players who are able to perform at the highest college level and in the NBA. The complex skills required to perform such drills may be too challenging for children. Thus, coaches may take drills designed for elite athletes and apply them to an average nine-, or thirteen-, year-old, but come away frustrated as the younger player struggles to complete the drills in a manner that improves performance during competition. An examination of some of the developmental differences between children and adults, in addition to a review of motor behavior theories, may benefit these youth coaches. Thus, the aim of this review paper is to provide youth coaches with conceptual models that may

lead to drills or coaching strategies that are most likely to aid teaching basketball skills in young players.

CHAPTER 2

CHILDREN VS. ADULTS: MOTOR DEVELOPMENT AND ITS IMPACT ON SKILL DEVELOPMENT

When structuring practice plans aimed at improving individual and team performance, youth coaches may benefit from acknowledging that children are not "miniature" adults. Some adults may see how easy it is for skilled collegiate or professional athletes to complete many basketball drills. However, these same adults may have a poor understanding of the hours of effective practice as a child that are necessary for the development of advanced skill sets typically seen in adult performance. Rather than take such issues for granted, youth coaches may benefit from considering how hard it is for children to correctly perform everyday activities such as balancing and running, and acknowledge that seemingly simple skills need to be "broken down" to elementary levels and practiced regularly if children are to begin mastering sport-specific skills in ways that lead to improved basketball performance.

Children typically evolve through a series of developmental stages that influence both their cognitive and motor performance (Payne, 2011). Throughout these stages there are several movement aspects that develop or change to become more efficient. This developmental evolution is evident in most gross motor skills, such as running, jumping and hopping. As described in running, these developments include arm positioning, stride length, foot-surface contact mechanics, the magnitude and rate of knee flexion, and

leg mechanics. As children grow and develop through these stages, their movements begin to change and adapt to the size of their body in the most appropriate way to perform the action (i.e., economically). Figures 2.1 and 2.2 depict the different ways that these five aspects change throughout the developmental stages as a child grows and matures.

It is important to note that not all individuals will progress to developmental stage 4 as noted in Figures 2.1 and 2.2. . Although this may not prevent individuals from performing an action, it may keep them from performing the movement in the most economic fashion. An example of this deficit could be the running motion of some professional basketball players. Their feet may not complete initial contact well with the ground or they may not make full knee or hip extension on their strides, however, they are still able to play basketball at a very high level.

This concept can also apply to younger individuals playing basketball. The ability of a young athlete to excel in a sport may cause a coach to assume that the young child is already fully developed. As discussed earlier, performance level may not be a direct correlation to the developmental stage of an athlete. In the eyes of a coach, a player may stand out when compared to another, leading the coach to believe that the advanced player may be fully developed from a motor perspective while the other is still growing. This scenario is not necessarily true, as the typical twelve year old is not fully developed and must still grow into their running motion. Therefore, the difference noted between the two players might be that one is still in the second developmental stage while the other is in the third stage for this motor activity, such as depicted in Table 2.1.

Advancing to the next developmental stage is based on a child's movement experience. In basketball, a fundamental movement that varies as more experience is gained as one evolves from child to adult, as more experience is gained, is the dribbling motion. It is common in the early stages of dribbling for kids to strike the ball with one or two hands instead of pushing the ball to the ground (Payne, 2011). The inexperienced dribbler appears to be spanking, or slapping, the ball to the ground, making it difficult to control. According to a film study conducted by R. L. Wickstrom in 1980, the inexperienced young child dribbler holds the fingers of the striking hand close together and sometimes slightly hyperextends the fingers at contact and then quickly retracts the arm after contact with the ball (Wickstrom, 1980). Combined with an undeveloped vertical peripheral vision and relatively poor hand-eye coordination, which is still developing, this motion leads to direction and control issues for the inexperienced dribbler. However, as individuals begin to practice and gain experience they start to push the ball towards the ground while nearly fully extending the elbow (Payne, 2011). The transition from novice to experienced dribbler also includes spreading the fingers when pushing the ball and using the fingertips more than the palm. Figure 2.3 provides images of the dribbling sequence of a youth basketball player. By using this motion, the player is able to gain more control of the ball and the direction he or she wants to dribble it. After players have gained experience in dribbling, they can then begin to more easily combine it with the running motion and start to complete basic dribbling drills.

Physiological variables change as children mature and are often influential factors in the ability of adults to perform more complex skills. Two important variables that affect the performance differences between children and adults is the fact that children

have higher resting and exercising heart rates. This physiological difference causes their hearts to beat at a much higher rate than adults during training ("Coaching Kids Successfully," 2011). As such, we cannot expect children to be able to step out on a basketball court and perform the same skills as elite college athletes. In a preliminary study comparing elite youth athletes versus elite college-aged athletes on measures of their cognitive, perceptual, and physiological scores on a variety of tests, the older elite athletes out-performed the younger athletes on nearly every measure (Derri & Kioumourtzoglou, 1998). The superiority of the older athletes in this study was very apparent, particularly under the motor abilities category; these findings suggest that even among elite youth athletes, meaningful physiological differences exist between youth and adult performers (Derri & Kioumourtzoglou, 1998). If these elite youth athletes are not able to perform at the same level as elite college-aged athletes, how can we expect the average child to perform at this level?

Since basketball is a game that requires a high level of awareness in order to play at an advanced level, it is important to note that a child's field of vision is not as large as that of an adult (Payne, 2011). In a study comparing peripheral vision in youth and adults assessed by catching a ball from different angles, the nine year old subjects made significantly more catching errors during the dual processing task than the subjects from the twelve year old, fifteen year old, and adult groups (Davids, 1988). Although these errors could possibly be attributed to catching mechanics, this finding allows one to understand that – with the continuous action which occurs during a basketball game - children often have a harder time than adults in seeing that open player in the corner, unless they are looking more directly toward them. It can also be inferred that a youth

basketball player more often have trouble catching a pass that is coming from a difficult angle, especially if they are moving and closely guarded. As a fully developed adult serving as the youth coach, it is easy to underestimate the difficulty of these tasks that seem natural to us but it is important to understand that during a child's youth their body is still growing and developing. As a player's peripheral vision begins to reach full development, "telegraphing" a pass will become much less common allowing a player to use their special awareness and deceive opponents on where they are seeking to pass the ball (Payne, 2011). Once a player is capable of doing this becoming a proficient passer should become more achievable.

After acknowledging children are not capable of performing physical skills at the same levels as adults or elite college athletes, coaches can get a better understanding of how to approach teaching children. Doing so will better position youth coaches to take drills from a variety of sources – such as camps and coaching clinics – and apply them in ways more likely to benefit their younger players. Such differences are why it is important for youth coaches to have an understanding of basic theories of motor learning and control, allowing them to introduce drills at appropriate levels and then progress according to skill acquisition.

CHAPTER 3

MOTOR CONTROL 101

In order to aid youth coaches in structuring more effective basketball practices, so as to improve individual and team performance, it is necessary to review some of the basic motor control concepts. First, three primary factors influencing motor performance will be discussed. Then, as a means of facilitating understanding of basic concepts, the ways in which sport scientists typically describe and categorize gross motor activities and sport-specific skills within this area of study will be addressed.

The three primary factors influencing any motor performance are the Person (organism), Place (environment), and Activity (task) (Schmidt, c2008.). Figure 3.1 provides a visual representation of this conceptual model. The Person (organism) is possibly the most important aspect of the three. Each individual possesses unique talents, abilities, and past experiences making him/her unique and influencing his/her potential level of performance. An individual that has experienced "a satisfactory level of maturation, has had previous movement experiences, a sociocultural background that are advantageous for performance, is motivated to excel, and is capable of maintaining an optimal emotional level" should be able to achieve a higher level of performance than one who has not (Schmidt, c2008.). These different levels are why it is important to tailor practices to the individual. Applying Schmidt's conceptual model to youth basketball, then, the coach is working with the player (e.g. person) toward the goal of shaping his or

her motor behavior. It is important to identify within the Person where s/he desires to perform the action because this typically plays a large role in how skill instruction should be approached.

The Place (environment) can be described as the location where the practice/event is going to take place. If one is teaching a player to correctly shoot a free throw, instruction/training best begins in a controlled environment where the focus can be on the movement. As the skill progresses, an environment including variability, such as simulating crowd noise or free throws with no time on the clock may be utilized. Further, addressing the environment could include practicing in a gym rather than outside at a park if the eventual goal is to play on a middle school team. Therefore, it is important for the player to practice in an environment as similar to the desired one as possible. Practicing outside could introduce increased variability that may not be present in a gym. Once the environment has been established it is necessary to figure out the activity/task that the player is seeking to improve.

The third factor that influences motor performance is the Activity (task), which is the desired action to be performed. For an individual to execute an action, it is important for them to analyze the situation and make a decision leading to the best outcome. A simple example of a task is how someone might choose to travel to school; they may walk the entire distance, board a school bus, or ride with a parent in the family car. Applying this concept to basketball, the task may be describe as taking a jump shot, attacking the rim and shooting a layup. A player must analyze the defensive positioning and choose the task that provides the best opportunity to score. Each of the these three concepts are vital to understand motor behavior, and youth basketball coaches are

advised to take these performance influencing factors into consideration when selecting individual drills and constructing practice plans.

Sport scientists also regularly use classification systems to describe and improve human movement. One-dimensional systems are the most basic form of classification and are widely used in clinical application. These systems simply identify skill characteristics based on one characteristic, such as where a movement is divided into two categories, with each representing extreme ends of a continuum. A classic example of a one-dimensional system is heat, which can be divided into two categories (hot and cold), with each having extreme ends of a continuum. Three widely used motor skill classification systems based on a one-dimensional system within sport science are: 1) size of the primary musculature involved, 2) specificity of where actions begin or end, and 3) stability of the environmental context (Schmidt, c2008.). Examples of each of these one-dimensional classification skills are shared below.

An example of a one-dimensional system using the size of the primary musculature involved is classifying a skill as fine motor or gross motor. A gross motor skill is classified as a large movement such as one that is done by the arms, legs, or the entire body (Magill, 2010). These movements are essential to being able to perform basketball skills, such as, the movements that are used to run down the court, guard an offensive player, jump for a rebound and many other basketball skills.

A fine motor skill is classified as one that involves small movements such as those done by the hands, wrists, fingers, feet, and the face (Magill, 2010). In basketball, these movements are not very prominent since most skills require whole-body

movements, although they play a large role in the success of skills such as dribbling and shooting. Shooting "touch" is difficult, if not impossible, to develop without some degree of fine motor control. Fine motor movements would also include the gestures teammates make to each other during a game, such as hand motions to set screens for one another on offense or tapping each other to switch on a screen on defense. They could also be used when the point guard uses hand gestures to call a play to be run on offense. Gross motor skills tend to overshadow fine motor skills since they are typically discrete skills, which are defined as a brief action with a well-defined beginning and end (Schmidt, c2008.). Although we classify skills as gross or fine motor, most movements are a combination of both using small and large muscle groups.

Fine motor skills may not be as noticeable; but they play an integral role in skill execution. Most basketball skills require a combination of gross and fine motor skills to be performed at a high level. In dribbling gross motor skills are evident in the running motion as well as the arm action. But fine motor skills such as the fingertip action in dribbling are necessary to perform the action. A combination of the two skills is used in the shooting motion as well. The jumping action would be classified as a gross motor skill, while the hand motion of flicking the wrist in the follow through is a fine motor skill. By using this classification of actions, or movements, we can describe all of the movements required to play basketball.

When using the specificity of where an action begins and ends to define motor skills, the movements are classified as discrete, serial, and continuous. Discrete skills, such as turning on a lamp, are the simplest since they are "organized in such a way that the action is usually brief and has a well-defined beginning and end" (Schmidt, c2008.).

Serial skills, such as opening a combination lock, are a bit more complex, as they require the individual to correctly execute a set of movements, in the proper order, to achieve the desired goal. Finally, continuous motor skills, such as driving a car, are the most difficult because the "skill is organized in a way that the action unfolds without a recognizable beginning and end in an ongoing and often repetitive fashion" (Schmidt, c2008.). When it comes to children, they are better at performing discrete skills such as shooting a free throw, compared to continuous skills such as guarding an offensive player. This reason is why it is important in basketball to develop fundamental movements at the youth level. These movements are essential when learning to play the game and are necessary to perform more complex basketball skills.

Environmental context stability is another important aspect in motor skill classification. This factor classifies skills as being open or closed. An open skill is one that is "performed in an environment that is unpredictable or in motion and that requires performers to adapt their movements in response to dynamic properties of the environment" (Schmidt, c2008.). Due to the environmental variability present, the individual must be able to adapt his/her movements and make them appropriate for whatever situation is presented. In basketball, being able to adapt to an ever-changing environment, such as defensive players reacting to offensive sets or an offensive player attacking the rim, is very important. These skills are typically more challenging to control, especially for novices such as children. A closed skill is one that is "performed in an environment that is predictable or stationary and that allows performers to plan their movements in advance" (Schmidt, c2008.). These types of movements are much easier for a novice to perform and a good starting point for children. As a coach, starting with a

closed skill to help teach the player the technique and progressing to an open skill by incorporating variability is essential to the holistic development of the player. Hitting a baseball off of a tee would be an example of a closed skill while hitting a pitched ball would be an open skill. As you will see in the multidimensional classification of Gentile's Taxonomy, these skills are characterized by the environmental context through regulatory conditions and inter-trial variability.

CHAPTER 4

GENTILE'S TAXONOMY

Gentile's Taxonomy of motor skills is a very helpful tool for determining the most effective ways to develop skills in children. This conceptual model was originally developed by Ann Gentile in an attempt to help physical therapists evaluate patients' motor skills and determine the best activities to help with their recovery (Gentile, 1987). This model also has great utility in sport science or coaching, such as when sorting drills for player development.

Gentile created a two-dimensional model for classifying motor skills, providing users with a system of relationships based on two general categories for sorting all forms of human movement: the environmental context and the function of the action. These two categories are each further broken down into two characteristics allowing classification of motor skills on a multi-dimensional level. This model is depicted in Table 4.1.

The environmental context is "the supporting surface, objects, and/or other people involved in the environment in which a skill is performed" (Magill, 2010). This category has two characteristics that help to classify motor skills. The first is regulatory conditions, which refers to "those features of the environmental context that specify the movements a person must implement to successfully perform a skill" (Magill, 2010). This is specifically the environment that surrounds the person such as the surfaces they are

walking on or if there are obstacles that may change the path of the person. The path used to walk to class is an example of regulatory conditions since the ever-changing environment would require the person to acknowledge different obstacles (other students, construction) on a daily basis that may alter their path. The second characteristic is inter-trial variability, which refers to "whether the regulatory conditions during performance are the same or different from one attempt to perform the skill to another" (Magill, 2010). An example could be walking across a specific street in the morning when no traffic or pedestrians are present and walking across the same street in the evening when there are many pedestrians and a lot of traffic. It is important to consider the environment where skills are performed due to the influence it can have on task difficulty and performance. Whether the skill is "opened" or "closed" is also very important when assessing the environmental context since this classification changes the skill requirements and possibly influences difficulty (Schmidt, c2008.).

The second general category is the function of the action, which is determined by whether or not performing a skill involves moving the body from one location to another (body orientation), and whether or not the skill involves holding or using an object (object manipulation) (Magill, 2010). Body orientation is referred to as "the changing or maintaining of body location" (Magill, 2010). It is characterized by body stability, "the skills that involve no change in body location during the performance of the skill," and body transport, "the skills that require the body to move from one place to another" (Magill, 2010). This aspect assesses whether the body is stable during an action or if the body must move from one place to another during the action. This characteristic has a large impact on the difficulty of the skill since an action that has the athlete remain in

place is easier to perform than the same action with a moving component added in. The second characteristic of the function of the action is object manipulation, which refers to "maintaining or changing the position of an object"(Magill, 2010). In the context of Gentile's Taxonomy, it is whether or not the action involves the use of an object, such as a ball, or not. "Skills that require object manipulation are more difficult to perform than skills that involve no object manipulation because the person must do two things at once" (Magill, 2010). They must first focus on executing the action without an object, and then an object will be added to increase the difficulty, requiring the players to focus on both things at the same time. The combination of the environmental context and the function of the action along with their more specific sub characteristics is what Gentile used to create her sixteen categories of motor skills. In Gentile's Taxonomy, it is easy to determine which skills are more complex because the complexity of the skill increases as you move across and down the table, with the simplest motor skill in the top left corner and the most complex in the bottom right.

CHAPTER 5

GENTILE'S TAXONOMY IN APPLICATION: REHABILITATION

A physical therapy setting is a practical example of how this taxonomy can be used, as Gentile was thinking of this field when constructing this classification model. First off, for physical and occupational therapists "it can be a useful guide for evaluation of movement capabilities and limitations" in their patients (Magill, 2010). This evaluation is the first thing therapists do with patients to give them information about the movements patients are capable of performing and what skills their injuries are keeping them from being able to perform. For example, a physical therapist could test the balance capabilities of a stroke patient, starting with balance assessment in very simple contexts and progressing to more complex situations until the patient is unable to perform the skill. This approach allows the PT to determine which characteristic caused the patient to fail at the skill and what areas of performance the stroke affected the most. After using the taxonomy to assess the patient's performance problems, it then becomes a "valuable tool for systematically selecting a progression of functionally appropriate activities" to help the person overcome his or her injury and improve his or her skill performance (Magill, 2010).

In this process of selecting what therapeutic activities would be most appropriate for the patient, the therapist must determine which skills they are unable to perform and

the best environment to start to improve these skills. This conceptual model aids the physical therapist in selecting the appropriate skills matched to his/her abilities, and then increases the complexity in therapy sessions until the patient is able to perform more complex skills. The therapist can "develop a program of rehabilitation or instruction by systematically increasing the complexity of the skills in the program"(Magill, 2010). Another practical use of Gentile's taxonomy in a physical therapy setting is to track progress of the patient as they work to achieve more difficult skills. "Because the taxonomy follows a simple-to-complex progression of skills, it provides an objective basis for determining progress in overcoming skill performance deficits" (Magill, 2010). This model provides an easy way for the patient's progress to be tracked depending on his/her performance of skills as they move along the table. The same practical application applied to therapy can also be used to explain the best way to coach children in basketball.

CHAPTER 6

GENTILE'S TAXONOMY IN APPLICATION: YOUTH SPORT

Table 6.1 contains an expanded version of Magill's description of Gentile's Taxonomy, modified to contain basketball-specific examples to help illustrate how the concepts within this model may be applied directly to the development of sport-specific skills. The complexity of any motor skill increases as we move across and down the table, with the most difficult skill to perform being in the bottom right corner. This taxonomy "can be a useful guide for evaluation of movement capabilities and limitations," allowing this concept to be applied to youth basketball (Magill, 2010). In general, when introducing and working with youth to master sport-specific drills, coaches typically should start in the upper left corner of Gentile's Taxonomy. Conversely, only highly skilled adults are likely to improve their skills by completing sport-specific drills from the bottom right corner of the Taxonomy.

In basketball, the environmental context, which is comprised of variables regarding regulatory conditions and inter-trial variability, can be described as where the game or practice is taking place and whether or not there are defenders present in the situation. The regulatory conditions of practice in basketball are very important. When some players practice on their own, they are shooting on an outside goal. The regulatory conditions between shooting in a gym and outside can be significant. When someone is

practicing outside there are many more factors that can negatively affect performance, such as uneven ground, smaller goals, and even the weather. These three factors are not encountered when one practices in a gym and can lead to inconsistency when switching back and forth. The regulatory conditions can also change when a person must complete the sport-specific skill against a defense, as it may demand different movements based on the movements of the defender or defenders (Magill, 2010). An example of inter-trial variability in basketball might consist of having players execute a layup alone on one trial and against a defender on the next. . As noted in the table, such a drill begins without defenders but as we move along the categories defenders are added to increase task difficulty. By adding defenders, the player must adapt to a changing environment where movement variability is required to complete the drills. Describing application of this principle more fully, suppose a young player is consistently unsuccessful in completing a layup drill against a defender. This lack of success suggests the player and the drill are poorly matched. Thus, the youth coach informed by this principle would "back down" or modify the drill so the player could complete it successfully on a more consistent basis. Once the player masters the modified layup activity, the coach can then at a later date re-introduce the layup drill against a defender. An example of the overlap of regulatory conditions and inter-trial variability in basketball is the shooting of free throws. The regulatory conditions would be stationary (e.g. the basket is 15 feet from the free throw line) and there would be no inter-trial variability (e.g. there is never a defender between the free throw shooter and the basket).

The second component of Gentile's Taxonomy centers on the function of the action, and it consists of two characteristics. These characteristics are referred to as body

orientations, which address the position of the body, and object manipulation, which is the presence or absence of an object. Applied to basketball, the function of the action would be whether the skill that is being performed requires the player to move around the court or be stable (body orientation) and if the skill is using a ball or not (object manipulation). A free throw would be a skill in basketball requiring body stability, while shooting a layup would be an example of body transport. When we are thinking about youth players performing some of these skills, we must realize that they are still developing. Children may be able to perform these skills but "they are thought to be deficient in the extensive practice required to stabilize the body," which causes them to be more inefficient than adults (Guarrera-Bowlby & Gentile, 2004). In a study comparing the sit-to-stand transition of children to that of adults, children showed similar form to that of the adults but lacked highly consistent coordination showing more variability (Guarrera-Bowlby & Gentile, 2004). The differences between adults and children in such a simple skill as a sit-to-stand transition can help us to understand the difficulty in performing more complex skills, such as shooting a layup or executing a jump shot. Before children can complete complex skills at an advance level "more extended practice and relative stabilization of body structure" must occur (Guarrera-Bowlby & Gentile, 2004). Having this type of stability is necessary in order to progress through Gentile's Taxonomy, since body stability is one of the model characteristics and task difficulty increases when requiring the body to move. Object manipulation would be whether to include, or omit, the ball during skill performance. At first, skills may be performed without a ball such as running through a play, which allows complete focus on the body movements required to execute the play. Then, after this skill seems to be mastered, a ball

would be added to increase the difficulty of performing the play. An example of the overlap of these two characteristics is a player dribbling a basketball up the court, which requires body transport and object manipulation. A youth basketball coach who expects a young player to dribble a basketball up the court before mastering either body transport or object manipulation is setting his players for frustration, and thus should structure practice activities accordingly.

When striving to develop basketball skills within a particular group of children, coaches can apply this table to their instructional techniques to develop a better understanding of the best place to start. Then, as the players individually and collectively improve their skills, the youth basketball coach can simply move along the table to increase the difficulty of the skill to continue challenging the young players. It is important to perform skills from each of the sixteen categories since each one "poses different demands on the performer in terms of the characteristics and number of variables the person needs to control and pay attention to in order to achieve the action goals" (Magill, 2010). For young players, performing skills from every category in a step-wise fashion is important as a developmental progression of less complex motor skills is essential when later trying to perform skills with increased complexity. It is much easier for a child to shoot a free throw than for them to execute a play. In short, youth coaches must realize differences exist between the college players they observe and the children they are coaching, and thus modify all drills and practice activities accordingly.

CHAPTER 7

ADDITIONAL MOTOR BEHAVIOR CONCEPTS THAT MAY IMPROVE COACHING, AND IN TURN, LEARNING

Although it is likely not effective for youth coaches to utilize drills that college coaches use, there are lessons that could be taken from these advanced athletes that would benefit children. As a coach, it is important to understand that there is not one set formula to correctly coach. Even if a 'successful' coach uses a specific behavior/practice type frequently, or coaches in a particular 'style' or manner, it does not imply that it will be either applicable or effective for another coach in a different context (Cushion, Ford, & Williams, 2012). The following sections discuss additional concepts that could be beneficial for coaches and enhance the learning process for their players.

Specificity of learning, where players are placed in a learning environment and perform tasks as close to the actual situation as possible, is important when it comes to structuring practices and is very beneficial for transfer to the performance situation (Schmidt, c2008.). For example, during a practice session, coaches should avoid extended periods of talking as well as long repetitive drills. Coaches should focus practice time on performing drills, with limited instruction, and save detailed/lengthy instruction for after practice. While instructing a player during a drill or correcting a move is acceptable, stopping practice for a lecture should be avoided. Structuring practice in this manner creates a session that is continuous in nature, allowing players to perform a variety of

drills for a few minutes at a time before moving to the next part of practice. For example, coaches could set up five different stations and put fifteen minutes on the clock, allowing three minutes at each station before rotating to the next station. This tactic provides a practice experience for players closely mimicking a game situation. In this practice scenario, players are performing a variety of skills every few minutes instead of doing defensive slides for ten minutes straight, which never happens in a game. This type of practice design is called a blocked practice since the players are performing a variety of skills over a shorter period of time instead of a repetitive movement over a long time (Schmidt, c2008.). Having players perform drills for long periods of time is not an effective approach since skills are typically performed for brief periods of time during a game. Breaking down each practice into shorter sessions where a different skill, or set of skills, is performed every few minutes has been shown to be better for learning, compared to several extended sessions (Magill, 2010). Evidence also exists that players tend to have better long-term retention of skills during a random practice, involving a variety of skills, as opposed to a block practice, where one skill is performed repeatedly (Schmidt, c2008.). A coach's goal when designing practice structure should be to create an environment as similar as possible to a game where the player must use many different skills over short periods of time. Once we have created an appropriate practice structure, the coach needs to focus on the type of feedback that they provide to their players.

The type of feedback coaches provide to players can be very influential in how players perform a skill. Players may respond to feedback differently and it is important for a coach to note the optimal way to work with each individual player. The most important thing about feedback is that the "learner is often not aware of any errors

without it" (Tzetzis, Kioumourtzoglou, & Mavromatis, 1997). In basketball, extrinsic feedback, where the learner is being provided with information from an outside source, is primarily used (Schmidt, c2008.). This type of feedback could contain information about the movement that the player was unaware of and unable to obtain on his/her own, allowing them to improve the motion. By establishing that the correct movement, or form, is not being performed, the player can understand the problem and change it to make it right. An effective mode of extrinsic feedback for youth coaches to provide is kinematic feedback, which consists of describing the aspects of the movement itself or the object that is being moved (Schmidt, c2008.). This feedback should help players learn the action more effectively than simply telling them they are doing something incorrectly. However, it is very important to keep the feedback clear, direct, and limited to avoid overloading players with information, especially children (Schmidt, c2008.). To improve feedback effectiveness, focus on the feature of the movement that will lead to the greatest improvement in task performance and work on correcting it (Schmidt, c2008.). Instead of focusing on practice drills utilized by college coaches, youth coaches could greatly benefit by focusing on how college coaches provide feedback to their players.

Youth coaches could also take a more mental approach to improving the motor skills of children. Performance in sports such as soccer, which is relatable due to ball handling, is not only dependent on motor skills but also relies on perceptual-cognitive skills as well (Ford, Yates, & Williams, 2010). These perceptual-cognitive skills include "the ability to use the visual system appropriately to extract relevant information from the performance environment, recognize situations in the environment via familiar structure and patterns emerging between players in the game, recognize early or advance

information from the postural orientation of an opponent or team-mate in the moments before a key event such as foot–ball contact, develop accurate predictions or probabilities in relation to what actions opponents and team-mates will undertake in a given situation; and make and execute appropriate decisions" (Williams & Ford, 2008). These skills are thought to interact continuously in a dynamic manner during performance (Ford et al., 2010). These same concepts can be applied to basketball and illustrate the importance of a player's cognitive skill. In a study comparing the relation of knowledge development to children's basketball performance, it was noted that both cognitive and motor skills contribute to the development of children's basketball skills (French & Thomas, 1987). It is important to note that children will not be capable of hypothetical and deductive reasoning until they reach the formal operational stage of Piaget's theory, which typically occurs around age eleven or twelve (Payne, 2011). Thus, it could be proposed, if coaches can improve the cognitive ability of their players, it will benefit their motor development. By improving children's knowledge of the game it should aid them in understanding the importance of being able to perform certain skills, which could ultimately lead to performance improvements of these skills. The challenge for coaches is to structure practice where perceptual, cognitive, and motor skills are all used at the same time. As mentioned previously, combining these different types of skills within a practice introduces variability in skill attempts, a random structure opposed to a blocked structure, creating a better learning environment (Ford et al., 2010).

Coaches could also incorporate motor imagery and visualization to improve skill performance. Motor imagery/mental practice can be described as where you are going through a movement, thinking out the individual phases of the movement and the

associated techniques that should be performed within each phase (Schmidt, c2008.). In a study observing the effectiveness of motor imagery in practice; the authors stated that a combination of motor imagery along with physical practice is the most efficient training condition for the acquisition of a new basketball tactical skill (Guillot, Nadrowska, & Collet, 2009). Visualization is where an individual sees him/herself performing the action either through his/her own eyes or a view from outside of the body (Schmidt, c2008.). When I think about visualization I think of every kid in their backyard imagining they are in a game where they hit the game winning shot. This is a good example of how a player visualizes taking a shot before actually attempting it. The previous example provides one avenue of how this technique can be practiced. Mental practice can come in a variety of other ways such as a gymnast going over her routine in her head before her event or a golfer repeating the swing mechanics from the last drive that sailed beautifully down the fairway (Magill, 2010). Each of these players had a different goal, however, each of them were able to utilize mental rehearsal/practice for their respective movements. In children, showing them the desired movements and having them mentally rehearse/practice the drill before performing the movement may help improve performance.

It is also important to acknowledge the role of the transfer of learning principle during skill acquisition. This principle can be described as the influence of having previously practiced or performed a skill on the learning of a new skill (Magill, 2010). Transfer can be described as positive, negative, or neutral based upon the effects it has on the performance of the new skill. A positive transfer of learning would occur when a previous experience facilitates performance of a skill in the learning of a new skill or in a new context (Magill, 2010). In basketball, positive transfer could be taking an effective

shooting performance in practice and using that to fuel the shots taken in a game. Negative transfer occurs when a previous experience hinders the performance of a skill or learning a new skill (Magill, 2010). For example, even though the movements appear similar in nature, a person with a history of playing baseball trying to learn the techniques of a golf swing may experience negative transfer, as the movements take place in two different planes and use different handgrip positions. These differences may increase the difficulty of learning the golf swing since motor patterns from the baseball swing may inadvertently get incorporated during performance. Since previous experience can play a vital role in learning a new skill, it is important for coaches to pay attention to how skills were previously practiced, previously learned skills that may lead to negative transfer, and finding the best way to transfer positive experiences from practice to competition.

CHAPTER 8

SUGGESTIONS FOR APPLYING MOTOR LEARNING AND CONTROL THEORY TO YOUTH BASKETBALL PRACTICE

When determining what teaching techniques to use in practice, it is useful to have tips ("hints") to serve as guidelines. These tips will allow coaches to optimize practice time and likely improve coaching effectiveness during practice.

- Object manipulation
- Master simple skills before moving on to more complex ones
- Focus on the fundamentals
- Parallel play for younger children
- Structure practice to mimic game situations
- Create a few team goals

Addressing bullet point number 1 more fully, our first and most important hint deals with object manipulation. When introducing a new drill or skill it is essential to always start without a ball. By removing the ball, players can focus solely on executing the movements required for the skill instead of worrying about what to do with the ball. Once players seem comfortable performing the skill, the ball can be included during successive skill performances to increase task difficulty.

This leads directly into our next suggestion where a player should be able to execute a simple skill before moving onto a more complex one. This relates back to Gentile's Taxonomy where we isolate different factors of a skill and then add them back in to increase the difficulty (Magill, 2010). By structuring the development of a skill in this way the athlete should be better prepared to perform a new skill since they should feel comfortable executing more basic skills.

Moving on to the next "golden nugget" for youth coaches, focusing on basic basketball skills is important to emphasize in practice. It is common to hear about the importance of fundamentals, however, coaches may be unsure of how to effectively incorporate these components into their practice. Using Gentile's Taxonomy is a great strategy to help add fundamental skills into practice sessions. Starting with the most basic skills, without variability, and advancing to more complex skills as the player improves, will aid the player in feeling comfortable with each movement as they progress through the sequence of learning. This strategy should help players adequately develop fundamental skills, become sound passers and dribblers, allowing them to control the ball more effectively. Sound fundamental skills will ease the difficulty of learning more complex skills, which include these fundamental skills, and reduce performance errors, such as turnovers. Additionally, players with sound fundamental skills can shift their focus to other aspects of the game to improve their overall performance, such as the cognitive and perceptual components of basketball.

Another suggestion that could be beneficial at the youth level is the use of parallel play where each player has their own ball and focus on drills requiring each child to individually use the ball, such as dribbling skill variations (Payne, 2011). Typically, in

youth basketball, players focus on ball location during the majority of game time and worry much less about guarding or screening. At a young age, performance is typically self-centered, not team oriented, making it difficult for coaches to work on these very important skills that are produced away from the ball. At this age there is the awareness of their teammates but there is a lack of a team goal (Payne, 2011). Therefore, as a coach, it is essential to find other ways to improve players' skills in practice that can translate to a game situation. Incorporating these drills where every player has a ball could make it easier to transition to other drills focusing on skills produced without the ball.

One of the most important suggestions is structuring practice and drills to mimic game situations. Coaches can alter the environmental stability throughout practice but it is important to initially use a closed environment (stable, predictable), so that the player can properly learn the skill technique. Once a player can execute the skill properly, coaches should shift towards an open environment (unstable, unpredictable) to increase variability and task difficulty. At the same time, coaches need to structure practice where drills are performed for short time intervals, which creates specificity of training toward the competitive avenue. This specificity tremendously helps the learner retain the new skill and be better prepared to execute it during a game.

Our last suggestion is to establish a few team goals prior to the season and possibly a couple of individual goals for each player while performing at the youth level. Goal setting has strong implications for helping learn a skill and could provide a positive outlook for a game where the team lost but players were seeing improvements in their passing, dribbling, or shooting skills (Schmidt, c2008.).

CHAPTER 9

CONCLUSION

The ability to apply motor learning, development and control theories to youth sports can be very beneficial if done correctly. It will prepare young players in a more appropriate fashion, benefitting their skill sets as they grow and develop. Coaches need to understand that children are not "miniature" adults, so their skills must be developed through effective practice activities and over time. Coaches adopting this mentality will find these concepts more appealing and useful, particularly for the long-term development of the young players they are coaching. By moving through skill progressions systematically, coaches may, more effectively, help children develop the skills necessary to perform the tasks correlating with each category in Gentile's taxonomy. These concepts can also help the coach easily identify lacking performance areas where each kid needs improvement. Coaches can use theories of motor learning, development and control to assess skill level, track progression, and provide insight on the areas that need improvement based on the characteristics that create the categories. This approach can allow coaches to individually work with players on specific skills needing improvement and track each player's performance progression. With this knowledge of motor control theories, youth coaches should be able to create coaching strategies based more on the abilities of the children and improving their fundamental

skills. By doing so, youth coaches can avoid the misguided practice of forcing children to perform drills designed, by college coaches, for older, highly skilled athletes.

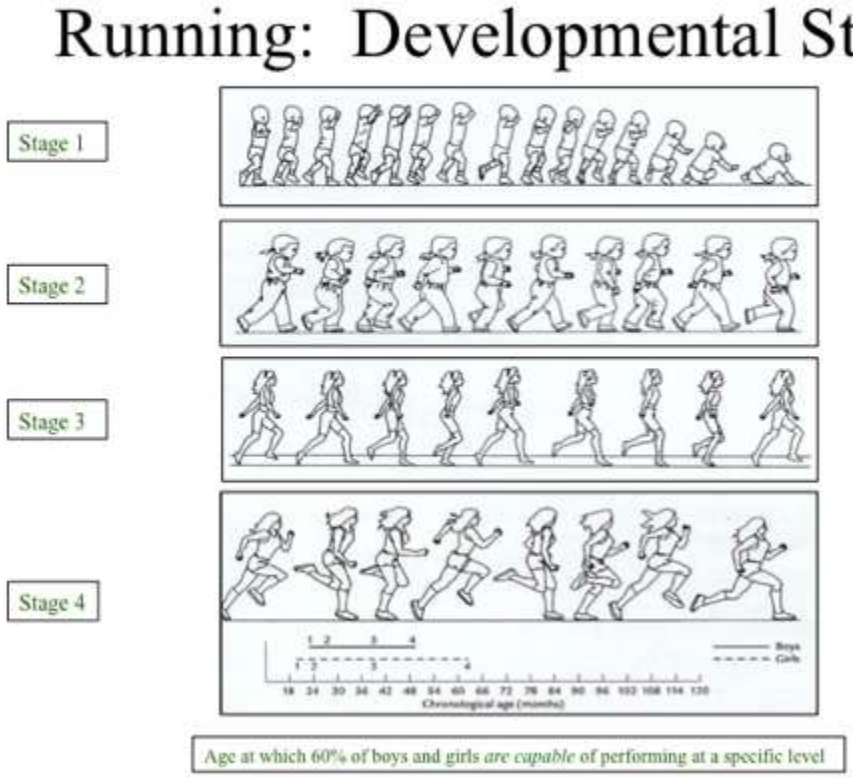


Figure 2.1: The four developmental stages involved in the progression of running. Adapted from Payne and Issacs, Human Motor Development, 6th Ed. 2008

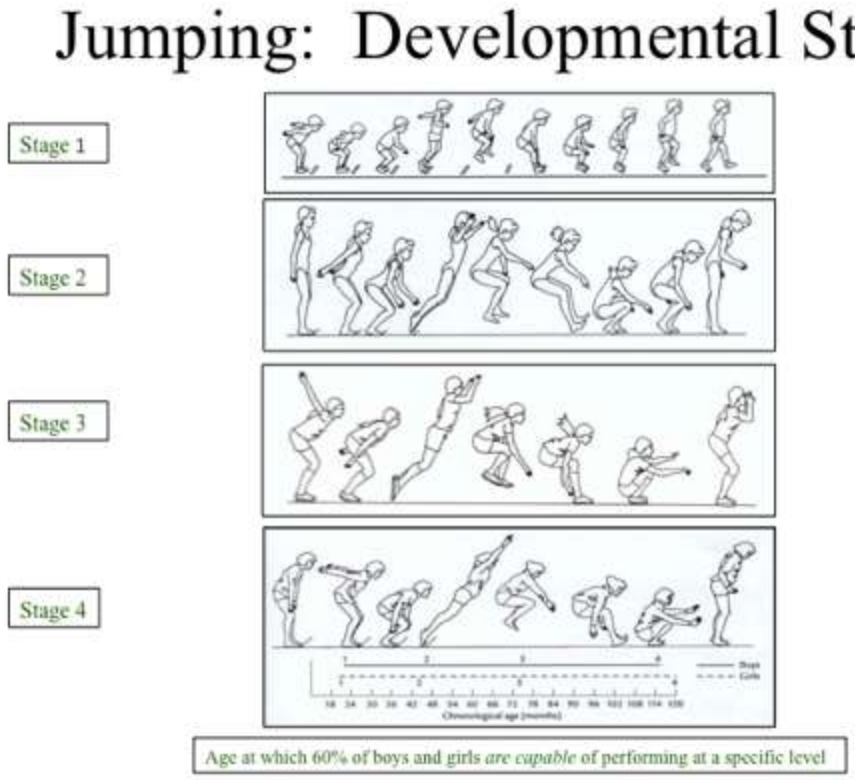


Figure 2.2: The four developmental stages involved in the progression of jumping. Adapted from Payne and Issacs, Human Motor Development, 6th Ed. 2008

Figure 2.3: Sequence of photos showing the dribbling motion of a youth athlete

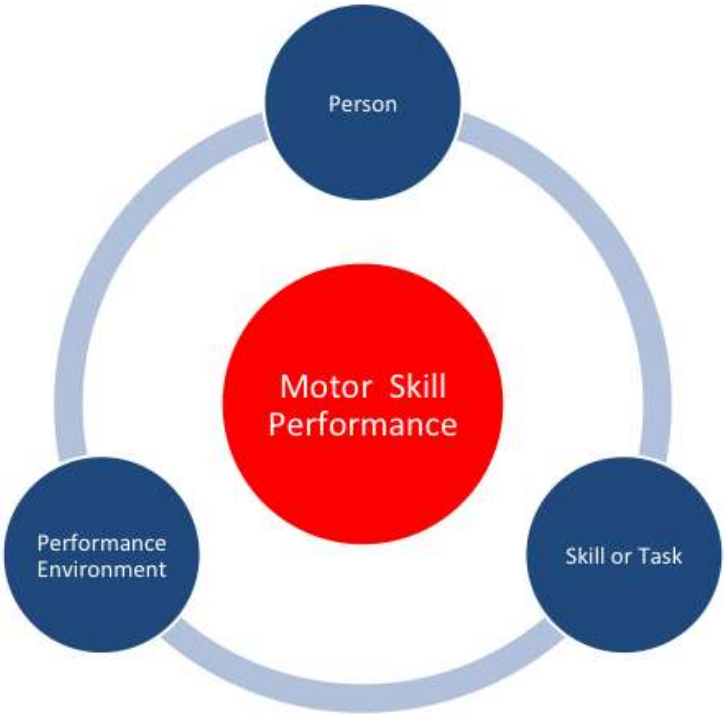


Figure 3.1: Influences on Motor Performance: The three primary factors influencing motor performance are the Person, Performance Environment, and the Skill or Task (Modified from Schmidt, 2008).

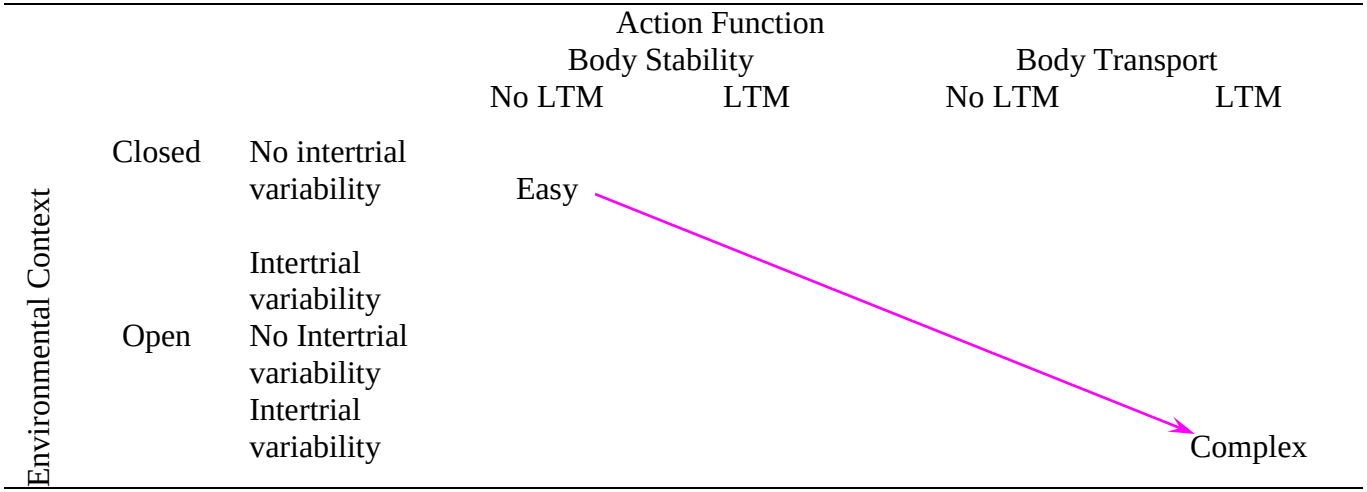
1. Lay up practice
    a. Second grader (8 y o): single line layup
    b. 5th grader (11 y o): lay up against dummy defense, limited in some way
    c. 8th grader (14 y o) lay up against live defense
    d. 11th grader (17 y o) lay up against 2 or 3 defenders
2. Pick and roll
    a. 2nd grader: 2 offensive players, single defender, who does not move
    b. 5th grader: 2 offensive players, 2 defenders, not allowed to switch
    c. 8th grader: 2 offensive players, 2 defenders, allowed to switch
    d. 11th grader: 2 offensive players, 3 defenders total, one in "help" from weak side of court
3. Post defense
    a. 2nd grader: 1 offensive player posting up, 1 defender, who works on position to be in
    b. 5th grader: 2 offensive post-players, who don't move, 1 defender, who works on the position they should be in depending on the ball position
    c. 8th grader: 2 offensive post-players, who are allowed to set picks and switch to opposite blocks and high posts, 2 defenders guarding them, one in help side the other fronting the post
    d. 11th grader: 4 offensive players, 2 in the post and 2 on the wings, who are allowed to move, set picks and switch to opposite blocks and high posts, 4 defenders guarding them, in the post one in help side the other fronting the post depending on ball position.

Figure 6.1: Progression scheme based on age/developmental stages for youth basketball.

Developmental Stages	Running	Jumping	Hopping
Stage 1	Arms are extended sideward at shoulder height	Vertical component of force may be greater than horizontal	Nonsupport knee is flexed at 90
	Stride is short and of shoulder width	Jump is upward rather than forward	Nonsupport thigh is parallel to surface
	Surface contact is made with the entire foot, striking simultaneously	Arms move backward, acting as brakes to stop the momentum of the trunk	Body is in upright position with arms flexed at elbows
	Little knee flexion	Legs extend in front of the center of mass	Hands are near shoulder
	Feet remain near surface		Force production is limited
Stage 2	Arms are carried waist high	Arms move in an A-P direction during the prep phase	Nonsupport knee is fully flexed – foot near buttocks
	Stride is long	Arms move sideward during the in-flight phase	Thigh of the nonsupport leg is nearly parallel to the surface
	Surface contact is made with entire foot, striking simultaneously	Knees and hips flex and extend more fully	Trunk is flexed
	Greater knee flexion	Angle of takeoff is above 45	Arms participate vigorously in force production
	Swing leg is flexed	The landing is made with the center of gravity above base of support	Balance is precarious
	Movement of legs becomes anterior-posterior	Thighs are perpendicular to the surface rather than parallel	Number of hops equals 2 to 4
Stage 3	Arms are no longer used for balance	Arms swing backward and then forward during preparatory phase	Thigh of nonsupport leg is vertical with knee flexed at 900 or less
	Arms are carried below waist level and may flex	Knees and hips flex fully prior to takeoff	Greater forward body lean
	Foot contact is mid-foot or	Arms extend and move	Greater distance in relation to the height of hop

	forefoot	forward during takeoff	achieved
	Stride length increases	Knee extension may be complete	Knee of nonsupport leg is vertical, but knee flexion varies
	Both feet move along a mid-sagittal line	Takeoff angle is > 450	Arms are used in force production
	Knee flexion on swing-leg flexion may be as great at 900	Upon landing, thigh is less than parallel to the surface	
		Center of gravity is near the base of support	
Stage 4	Foot contact is mid-foot or forefoot (forefoot in sprinting)	Arms extend forward and upward upon takeoff, reaching full extension above the head	Knee of the nonsupport leg is at 900 or less
	Arm action is in opposition to leg action	Hips and knees are extended fully	Entire leg swings back and forth like a pendulum to aid in force production
	Knee flexion is used to maintain momentum during support phase -In excess of 90	Takeoff is <45 Upon landing, thighs are parallel to the surface Center of gravity is behind base of support	The arms are carried close to the body, elbow at 90
	Swing leg may contact buttocks during recovery	Knees flex and arms thrust forward at contact in order to carry center of gravity beyond the feet	Nonsupport leg increases force production, so arm use decreases

Table 3.1: The progression of movements through the four developmental stages in three skills: running, jumping, and hoping. Modified from Payne and Isaacs "Human Motor Development: A Lifespan Approach (2011).



**LTM stands for limb transport manipulation, referring to whether an object is used or not*

Table 4.1: This is the basic concept of Gentile's Taxonomy.(Gentile, 1987)

	Action Function			
	Body Stability		Body Transport	
Environmental Context	No Object Manipulation	Object Manipulation	No Object Manipulation	Object Manipulation
Stationary Regulatory Conditions and No Intertrial Variability	1A Body Stability No object Stationary regulatory conditions No intertrial variability • Practicing a basketball free-throw shot without a ball	1B Body Stability Object Stationary regulatory conditions No intertrial variability • Practicing basketball free-throws	1C Body Transport No object Stationary regulatory conditions No intertrial variability • Practicing a play multiple times without using a ball	1D Body Transport Object Stationary regulatory conditions No intertrial variability • Practicing a play multiple times with a ball
Stationary	2A	2B	2C	2D

Regulatory Conditions and Intertrial Variability	Body Stability No object Stationary regulatory conditions Intertrial variability • Shooting a basketball from different areas around the court without a ball	Body Stability Object Stationary regulatory conditions Intertrial variability • Shooting a basketball from different areas around the court with a ball	Body Transport No object Stationary regulatory conditions Intertrial variability • Practicing multiple plays without using a ball	Body Transport Object Stationary regulatory conditions Intertrial variability • Practicing multiple plays with a ball
In-Motion Regulatory Conditions and No Intertrial Variability	3A Body Stability No object Regulatory conditions in motion No intertrial variability • Passing basketballs to a	3B Body Stability Object Regulatory conditions in motion No intertrial variability • Shooting a basketball from	3C Body Transport No object Regulatory conditions in motion No intertrial variability • Practicing a play without a ball but	3D Body Transport Object Regulatory conditions in motion No intertrial variability • Practicing a

	moving player running the same pattern several times, without a ball	different spots on the court while moving in a distinct pattern	with moving defenders	play with a ball and moving defenders
In-Motion Regulatory Conditions and Intertrial Variability	4A Body Stability No object Regulatory conditions in motion Intertrial variability • Passing basketballs to a moving player running different patterns, without a ball	4B Body Stability Object Regulatory conditions in motion Intertrial variability • Shooting a basketball from different spots on the court while moving in varying patterns	4C Body Transport No object Regulatory conditions in motion Intertrial variability • Practicing several plays without a ball but with moving defenders	4D Body Transport Object Regulatory conditions in motion Intertrial variability • Practicing several plays with a ball and moving defenders

Table 6.1: An in-depth look at Gentile's Taxonomy applied to basketball. Modified from Payne and Isaacs "Human Motor Development: A Lifespan Approach (2011).

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