

Improving Basketball Shooting Technique:

A Constraints-Led Approach

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Abstract

Background: The Constraints-Led Approach (CLA) to motor skill acquisition and performance can be applied to any sport and any level of performance where motor skills are a component. One of the most important basketball skills developed by youth athletes in basketball is the ability to properly shoot the ball.

Purpose: This main purpose of this project was to investigate the application of the CLA in the improvement of basketball shooting technique among youth basketball players. This project leveraged the CLA non-linear pedagogical approach in the form of the Environmental Design Principles (EDP) as well as the Driska (2019) Five Criteria for a Good Drill worksheet as session frameworks.

Findings: This project produced several seminal findings in support of the CLA to improve motor skill acquisition in the shooting of a basketball. This project, and the associated training session, demonstrated that the effective use of the CLA can produce significant improvements in basketball shooting technique and form.

Discussion: The implications of this project signal a new and effective method for the teaching of motor skill acquisition in the sport of basketball. By avoiding explicit and overly-verbal instruction focused on some “textbook” technique and allowing the athlete to discover their own solution to goal-directed activities, a successful motor skills solution can be found that results in improvement.

Keywords: affordances, optimal grip, implicit instruction, invariant, degrees of freedom

Introduction

In the game of basketball there is no more important skill than the ability to shoot a basketball and score. This axiom is true across all age ranges and levels of play in the game of basketball. It is also true that every player will develop their own unique motor skills solution to shooting a basketball. While each individual develops a unique solution there are also a number of features of a good shot. For example, the arch of the shot, the rotation of the ball, the use of the fingertips instead of the palm, and the placement of the shooting and non-shooting hands. Yet, even the aspects of a “good shot” from a motor skills perspective are never the same among players. Given that every player will arrive at a unique motor skills solution in a non-linear fashion, it is critical that coaches and practitioners employ a non-linear pedagogical approach when working with players on their shooting technique.

The Constraints-Led Approach (CLA) to motor skills acquisition is a non-linear approach based on the idea that every athlete is unique and develops their movement skills in a non-linear fashion throughout the lifespan (Chow, Davids, Button, & Renshaw, 2016; Davids, 2010; Davids, Button, Bennett, 2008; Handford, 2006; Renshaw, Davids, Newcombe, & Roberts, 2019; Wormhoudt, Savelsbergh, Teunissen, & Davids, 2018). The CLA also recognizes that the athlete is not a solitary entity in the movement skills equation and that other factors such as the task and the environment play a role in shaping and influencing the final movement solution. This project will detail how using a non-linear CLA can increase technical efficiency and guide athletes to a state of optimal grip (Renshaw, Davids, Newcombe, & Roberts, 2019) in shooting a basketball.

Dynamical Systems Theory

Dynamical systems theory is a framework based on the concept that complex biological systems, or organism-environment systems, with varying degrees of freedom (DOF) will use these DOF through the process of self-organization in order to discover a movement coordination pattern to solve a motor skills task (Chow, Davids, Button, & Renshaw, 2016; Davids, Araujo, Seifert, & Orth, 2017; Davids, Button, & Bennett, 2008; Renshaw, Davids, Newcombe, & Roberts, 2019; Schmidt, Lee, Winstein, Wulf, & Zelaznik, 2019). Davids and colleagues (2017) describe dynamical systems theory as a “multidisciplinary, systems-led approach encompassing mathematics and physics, and their extension to biology and psychology”. Dynamical system theory, when integrated with the field of study known as ecological psychology, forms the foundation for ecological dynamics.

Ecological dynamics is described as the interaction and relationship between organisms and their performance environments (Davids, Araujo, Seifert, & Orth, 2017). The main goal of ecological dynamics is to “understand the relationship between an athlete and key properties of a performance environment” (Davids, Araujo, Seifert, & Orth, 2017). The key properties that Davids and colleagues are referring to here are the different organismic (or individualistic), environmental and task constraints that were first proposed by Newell (1986) through the use of his seminal schematic pyramid diagram. Newell (1986) proposed this framework to describe skill development and how all three characteristics of skill development are inextricably linked in the role of skill development. According to Newell (1996), this framework can be used to “determine for a given organism the optimal pattern of coordination”. Newell’s (1986) model of skill development is an ideal foundation on which to base a non-linear pedagogical approach like the CLA. The CLA is based on the same theoretical underpinnings that an inextricable link

between the performer, the task, and the environment exists and it is this coexistence between these constraints where the organization of movement system DOF occurs (Chow, Davids, Button, & Renshaw, 2016, Padmanabhan, 2017).

Constraints-Led Approach (CLA)

The CLA framework for motor skills acquisition is based on the aforementioned theory of ecological dynamics where both sports teams and individuals are considered to be “complex adaptive systems” (Renshaw, Davids, Newcombe, & Roberts, 2019). As complex adaptive systems both individuals and teams are faced with constraints that act on their performance in many environments including sports. For example, a football team might be faced with environmental constraints by having to play on an overly wet and soggy field in the rain or snow. A soccer player might be faced with individual constraints such as their weight or height compared to other players. This is where the perception and the action of individuals and teams come together to produce action regulation. Regulation that is the result of opportunities for action or, in the CLA framework, affordances.

Ecological psychologist James Gibson (1979) coined the term “affordances” which is defined as the opportunity for action. According to Gibson (1979), “the affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill. The verb to afford is found in the dictionary, the noun affordance is not. I have made it up.”. These same affordances are what we, as practitioners and coaches of CLA, need to ensure we invite our athletes to engage. However, the affordances provided to our athletes need to be well planned out with a focus on positive transfer and retainability. This is true across all motor skill acquisition tasks and can be applied specifically to the shooting of a basketball.

Constraints-Led Approach (CLA) in Basketball

There is a growing body of research to support the use of a CLA for a positive transfer and skill acquisition in the sport of basketball and specifically with the act of shooting a basketball (Chow, Davids, Button, & Renshaw, 2016; Oudejans, R. R. D, Koedijker, J. M., 2006; 2010; Wormhoudt, Savelsbergh, Teunissen, & Davids, 2018). Chow and colleagues (2016) point out that shooting in the game of basketball is filled with variability. This is the same variability that a CLA, when properly implemented, can provide to participants.

Method

The methodology used for this project was based on the core concepts of the CLA along with support from the principles described in the Five Criteria for a Good Drill (Driska, 2019) worksheet. The entire training session will be recorded at the Crofton Middle School gymnasium in Crofton, Maryland on Wednesday, April 3rd, 2019 between 6:30PM and 7:30PM. The implementation of a training session around shooting a basketball was planned and organized to provide a landscape rich in affordances with respect to shooting a basketball.

Participants

For this project there were four (4) total participants including myself. The first participant was Michael Pessia who is 10 years old and who played basketball on my winter intramural basketball team this winter season. Michael loves to play basketball and just wants to have fun with his friends while playing. He is average in his height and weight for his age and is technically at a recreational level. Anthony Pessia, one of Michael's brothers, who is 12 years old, assisted in the drill by playing the role of a rebounder and a defender. Finally, Thomas Pessia, who is 14 years old and Michael's oldest brother, operated the video camera and recorded the session in the gymnasium and also on their front porch when I dropped them off at their home after the session. All three (3) boys are homeschooled and each of them plays basketball at

a recreational level. All participants were contacted two (2) weeks prior to the schedule filming date. The reason for their selection was that we have known the family for a number of years and Thomas was on my team during the winter season and desperately needed help with his technical shooting form.

I was the fourth participant and I have been coaching youth sports for just over 30 years. I coached my first basketball team as an 18-year-old high school senior at the Boys and Girls Club of Santa Rosa (California). At that time, the only coaching training I had was from watching my uncle, Tom Bonfigli of Cardinal Newman High School, who is among the winningest coaches in the state of California with over 750 victories. Tom's coaching style is best described by the following [image](#) from 2017. I initially tried to emulate his coaching style, which was an extreme version of the explicit coaching style. I have also coached youth soccer for a number of decades, and this is also the sport context where the majority of my coaching education has taken place. I currently hold the United States Soccer Federation (USSF) C, D, E, F, Youth National, and Goalkeeper licenses in addition to the National Soccer Coaches Association of America (NSCAA) Advanced National, National, Advanced Regional, Regional, State, National Goalkeeper, and Youth National diplomas. Finally, I hold my International Coaching License (the UEFA B license for non-EU residents) from the Football Association (FA) of England which was a 28-day residential course conducted at the Lillleshall National Sports Centre in Shropshire, England. As a result of my training my coaching style has shifted significantly from an explicit style to more of a questioning coaching style based on CLA.

Procedures

In order to provide an optimal training environment this project leveraged both the Driska (2019) Five Criteria for a Good Drill worksheet in combination with the Environment Design

Principles (EDP) that tie the theoretical concepts of ecological dynamics to the real-world application of CLA in a sport context (Renshaw, Davids, Newcombe, & Roberts, 2019). This design is also proposed as a bridge between theory and practice for a CLA to basketball shooting technique. Both the Five Criteria for a Good Drill worksheet (Driska, 2019) and the EDP (Renshaw, Davids, Newcombe, & Roberts, 2019) operationalize CLA for practitioners by providing a framework for practice design.

The first step in the practice environment design for my session was to determine the session intention which, according to Renshaw and colleagues (2019), “do not just impact on our decision-making as coaches, but act as an over-riding constraint (*individual*) on performer and team cognitions”. My session intention was to improve the technical shooting ability of Michael with a basketball by providing an affordance landscape where Michael could “*explore, exploit, or execute* solutions” to the task and attune to the performance environment. While the session intention is not specifically addressed in the Five Criteria for a Good Drill worksheet (Driska, 2019), it is an implied component of the worksheet and the basis on which the worksheet is based. As part of the session intention a number of task constraint components were procured to add value to the session. Several basketballs with hand prints, vinyl basketball floor disks, and a Ball Hog hand wrap were all purchased to support the session intention. In addition, there was significant planning with respect to the level of the session participant. Michael is a novice basketball player (age 10) and currently plays at the recreational level. According to Renshaw and colleagues (2019), a key consideration when determining the session intention is the assessment of the performer and their current level of expertise in the session task.

The second step in the process was to provide an affordance landscape with supporting task constraints. This involved the creation of a practice plan with a progression from basic

basketball shooting technique queues to several task constraints. Keeping with the CLA to coaching and the idea of “*constrain to afford*” (Renshaw, et. al., 2019), a number of task constraints were planned for the session. The first task constraint was to provide Michael with an appropriately-sized basketball for his age if he was not having success with the full-size leather ball. The next task constraint was built-in to the smaller (28.5-inch) basketballs and that was the markings on the balls. Each of the smaller balls had hand images on them to which Michael would be able to attune for better technical shooting form. The next task constraint was the use of vinyl basketball floor discs that could be placed in different locations around the basketball court. These vinyl discs were used to invite Michael to engage in shooting from a different location on the court each time, but still close enough to the basket that he should have success. A third task constraint that was not used, due to time limitations in the gymnasium, was a device called the “Ball Hog”. The Ball Hog is a device that is strapped around the palm of the shooting hand and has a small bump on the strap, so the basketball is not able to rest against the palm of the shooter’s hand. This task constraint is used to invite the athlete to use their fingertips when shooting. The final task constraint was Michael’s older brother, Anthony. Anthony was used as a live defender at the end of the session to simulate a performance environment that was more game-like. All of these constraints matched up nicely against the aforementioned session intention.

The third step in the session preparation was to formulate a representative design (Brunswick, 1955) for learning based on transferability, appropriate challenge points (Gray, 2018), and variability. In other words, I was trying to create a practice environment that was as close to the performance environment as possible given Michael’s level of skill. For example, Gorman & Maloney (2017) found that the practicing of basketball shooting without defenders

could result in negative transfer and a movement solution that will be ineffective when transferred to a performance context. However, the current skill level of the participant(s) must also be taken into account when creating a Representative Learning Design (RLD). According to Renshaw and colleagues (2019), novice athletes can still benefit from a de-contextualized RLD, but this type of training, once the foundational features are understood, will have a very short shelf life in terms of being of benefit to the participant. For these reasons and given the fact that Michael would be considered a novice having not played organized basketball prior to this past winter, my RLD started with affordances for Michael to experiment with proper hand placement on the basketball and a large number of shooting opportunities.

The fourth and final consideration for the preparation of this session was the idea of variability (Driska, 2019) and repetition without repetition (Renshaw, et. al., 2019). In order to use a CLA to provide variability I employed the use of five (5) vinyl disks which were placed in different locations around the key. The reason for the use of the vinyl disks was to ensure that Michael didn't stand in a single location for every shot. This also provided me with an opportunity to use the CLA through the use of problem setting for Michael. The disks were numbered 1 through 5 and without any instruction from me, Michael immediately picked up on the fact that he would start at disk 1 and then move in numerical order from disk to disk. I provided no direction other than to let Michael know that he should shoot from the vinyl disks. He clearly figured out the idea behind the disks, again, without instruction, and quickly moved to each disk in turn.

In addition, variability was used to adjust the challenge point (Driska, 2019; Gray, 2018) for Michael and this was also done to introduce a more representative learning design and environment. Michael's older brother Anthony was introduced as a defender so that Michael was

not shooting without some sort of defensive pressure. In the game of basketball, it is highly unlikely that there will be no pressure when shooting. Anthony was used to pass the ball to Michael and then Anthony would come out as a defender to contest each shot that Michael was taking.

Results

The results of the implementation of a CLA to shooting a basketball proved to be both constructive and beneficial for the participant as well as myself. I felt that a number of aspects of the session worked well. The first aspect was that a CLA can effectively be used to influence the technical shooting of Michael. This was immediately apparent in the video when the ball with handprints was given to Michael instead of the full-sized basketball. His shot had more arc, better rotation, and he was able to use his fingertips instead of his palm. That said, the introduction of the task constraint of a ball with hand prints clearly slowed down his shooting motion. However, this is to be expected and it not the result of negative transfer. It is just the opposite. The rate of learning might have slowed down due to the introduction of the ball with handprints, but the long-term transfer and retention is increased. In other words, while the introduction of the ball slowed down the mechanical shooting motion of Michael, the long-term transfer is worth the degenerative impact on his shot.

The second takeaway was what did not work as part of the project. While not seen in the recording there were several logistical challenges that had a severe impact on the overall recording of the project. First, we were told we could start recording at 6:30PM, but we were held off the courts until 7:45PM. This decreased the amount of time I had to work with Michael and forced me to condense the session significantly. I wanted to introduce another task constraint, but due to the time constraints I was unable to introduce the “Ball Hog” device that is

used to invite the player to use their fingertips to shoot the ball instead of the palm. The time constraints were apparent in the training session after-action scene where we had to film that portion of the video on the front porch of Michael's home. Not only did I coordinate with their parents to have them all home by 8PM, the gymnasium closed at 8PM. Finally, due to being rushed at the end of the session, I felt that I was more concerned about time than my session.

Next, I feel that my questioning style of coaching worked well during the session. I was able to ask Michael about the impact of shooting while lying on the gym floor, what he thought the handprints on the ball might be there for, whether he was having fun, and if he felt like his shot had improved. Also, during the session I was able to avoid the use of explicit instruction in Michaels' shooting technique, but still saw almost immediate improvement in his shooting technique. I simply told Michael to "make as many shots as you can".

The final takeaway from my session was that Michael, as well as his brother Anthony, both had fun. For me this was the most important aspect of the session, especially after having to wait for an extended period of time sitting in the gym before we actually began to record. As a 'Thank You' I also gave each of the three (3) brothers one of the balls with the hand prints on them. They really enjoyed the session and when taking them home they actually asked me if I was going to be doing another project and if they could assist.

Discussion

The overall goal of this project was to conduct a training session on basketball shooting technique based on the CLA. Based on the results seen in the video as well as during the session itself I felt that my overall goals were achieved. Michael's shooting technique improved substantially from when we began the session. One of the challenges in assessing the long-term impact of the CLA, however, is determining whether my instruction effects Michael's shot in the

long term. If we are saying that each individual will develop their own individual and unique movement skill signature, did my instruction actually get Michael there faster than he would have eventually arrived at his solution to the task.

The feedback from peers provided a number of very valuable insights into the session and my application of CLA as well. The first learner to respond mentioned that the use of the ball with the handprints was a great idea, but Michael became overly concerned with his hand placement to the point that it slowed down his shot to the point where it took 5-7 seconds to get off a shot. As previously mentioned, I feel that this was okay given Michael's level of skill and age. When his brother Anthony was added as an active defender you could immediately see the increase in speed in Michael's shot. He was faced with the perception-action coupling of a realistic defender, the closing of space, and having to get his shot off at a much faster pace. One thing that was interesting from a basketball perspective, and where I think I could have added value, was to ask Michael if there were any other approaches he could take to score other than take the shot from where he was on the floor immediately after receiving the ball. I didn't give explicit instructions that this was what he had to do, and he never drove with the ball against the defender. Had I asked him about other approaches to score after receiving the ball, that might have invited him to attack the defender and the rim by driving the lane.

Additional feedback talked about making the drill more realistic with a better representative design and this was a very good point. When in a basketball game does the defender pass the ball to an offensive player and then defend against that player from the baseline. It simply doesn't happen. In reflecting back on the logistics of the drill I feel that instead of running the drill with the defender passing the ball to the offensive player, maybe I should have passed the ball to the offensive player and then the defensive player would come out

to defend once the ball has been passed. However, this could also be seen as a non-representative design (when does the coach pass you the ball in the game?) that might lead to negative transfer.

Finally, the topic of the task constraint change with the ball size was seen as an appropriate action to take given Michael's level of skill and age. The feedback agreed that this was a good idea and one learner mentioned that maybe it would have been a better idea to give him the right size ball but without the handprints. I am not sure I agree with this as, again, I feel that the degeneracy in his shot motion would lead to a better end solution than me taking an explicit approach and telling him where to place his hands on a ball with no markings.

Implications for Future Coaching

One of the core concepts of the non-linear constraints-led approach is the idea that each and every individual athlete will arrive at their own unique movement solution to any goal-directed task. Just as every human has a unique fingerprint, so too do they have unique movement solutions. By providing athletes with a landscape of variability and affordances, coaches and practitioners can better prepare performers for the unstable and unpredictable realm of sport competition. According to Renshaw, et. al. (2019), "individual athletes who become attuned to relevant affordances are considered to have developed "optimal grip". In other words, athletes and performers who have developed optimal grip are those who can seize on the affordance opportunities presented to them and self-regulate in any performance context (Renshaw, et. al., 2019). My hope is that through using the CLA to coaching I will be able to inspire more youth athletes to continue participation in sport and in their acquisition of motor skills.

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