

Biomechanical characteristics of various sports - Part 2

So now the characteristics in the dominant skill set would be that of reactive ability and agility right now, where would this be important? As you can see in the picture in the game of squash, right? So players are constantly reacting to where the ball is coming from the ball and what's the trajectory of the ball. You need to have that cue fed in if players or your athletes are able to understand how high the ball is going to land, where the ball is going to land, if there's any deviation. Another example of same would be for tennis because you always mostly play with a bounce or in cricket where you need to understand ball trajectory kinematics as well. So players need to quickly or swiftly react to the ball's trajectory and change their directions rapidly. Hence, need to have really good reactive ability and agility. You know all of these characteristics also give you an insight into if you are performing any kind of talent identification or if you have an athlete that is playing multiple sport, so maybe he's playing badminton and swimming or sprinting and badminton.

If they have naturally or they can develop this skill set, you can try and push your athletes towards that particular sport, right? So in and all these are important characteristics also to consider when you're doing talent identification or to develop talent for that particular sport. So back to the squash example. So you need to react quickly to the ball's trajectory, change your direction rapidly to maintain good position on the court. You always need to be aware.

Again, here you would need your spatial awareness, extremely important. And note that there is limb and hand-eye coordination here as well. But when it comes to the dominant skills coordination, but when it comes to a dominant skill set, it is reactive ability and agility. Another such example would be table tennis, right? So a lot of back and forth, half, sorry, a lot of back and forth, a lot of fast paced rallies. So in table tennis, you need a swift response as we spoke about.

Fast paced movements of the ball would require you to have quick reflexes and also precise hand movements. So these precise hand movements would be to give your stroke direction, right? It would also be to generate spin and also for speed, or it could also be a combination, right? So just look at dissecting your movements so that you understand the underlying building blocks, the underlying syllables as we speak about or the ABCs to be able to build that for your athlete. So again, reactive ability and agility, table tennis extremely important. Another characteristic would be endurance and stamina. So you could have sport that is dominant in endurance and stamina.

For example, as you can look at in the picture, it is road biking, right? So cycling or road biking, you would require high levels of endurance and stamina. So why would that be? It is to sustain your energy levels for prolonged activities. So prolonged physical exertion, athletes need to develop muscular endurance. So to sustain long periods of physical

exertion, you would require muscular endurance. You need to build muscular endurance and athletes also need to develop proper pacing and breathing techniques.

So this is extremely important, not looked at quite often, but extremely important to look at your breathing efficiency. Right? So how would you pace different strategies and also looking at different breathing techniques as well to optimize your performance? Of course, we've looked at from the needs analysis point of view that your, so all of your, let's do it again. So from a needs analysis perspective, we've also looked at optimizing your gear, in this case, your bike or your cycle. You know, what's the importance of this saddle height, you know, the wheel configuration and everything. But apart from that, it's also important to have endurance and stamina to optimize performance.

So another characteristic of the dominant skill set would be strength and power. You can also categorize sport based on dominant in strength and power. So as you can see from the image over here, weightlifting, powerlifting, all of these could be an excellent example. So emphasis here is on maximum strength, right? So emphasis again, maximum strength and explosive power. So when you're looking at the sport and designing training programs for this athlete, you also look at developing this strength and explosive power with good technique.

Right? Of course, good technique. And these two combinations will help you achieve what we call as, they help you achieve mechanical efficiency. Oops. Right? So good technique, along with developed strength and explosive power, help you achieve good mechanical efficiency. So they use defined technique so that the lift exceeds your weights.

Another body weight would be gymnastics, and gymnastics and the beam. Right? So they use body weight to perform varied movements like your flips, twists, holds, any routine on the bar that requires high strength to weight ratio and body control. Right? So through your body control and strength, you can perform all of these movements efficiently. Another dominant skill set would be if you look at overall, you know, body weight. Right? Let's look at specifically sport that require upper body strength.

Right? So as you can see from the picture, rowing would be an excellent example. So we have rowers that predominantly use their upper body. So their lower body is quite stationed and it's more the use of core and your upper body to produce the oar speed. So the back, shoulders and arms become extremely important. So this muscular strength in those areas are required to propel oars through the water with technique focused on generating power.

Right? So it's quite upper-body dominant. Same as your upper body, let's look at an example of where it would be lower body dominant. Right? Again, bear in mind that it is lower body dominant, not that you're using only lower body. Right? So most sport or almost all sport require a combination of both. It's never isolated as much.

Right? But you can also all, but you can have a dominance in this case, it's lower body dominance in sprinting. So mostly sprinters rely on lower body power and strength. So you know, all of your ground reaction forces, you know, transferred up through your lower body into the hand that help you propel forward. Right? So your major muscles of the hip, your cords, your hamstrings are the ones that produce strength and explosive power. Right? So cord, the steps, hamstring, and glutes to generate explosive power.

If you were to train your athlete for explosive power, what would you do? You would do a lot of plyometric training where you develop explosive power. You also need to have good muscular strength. Excuse me.

Oops. Right here. You need to have developed good plyometric training protocol, good muscular strength and also muscular endurance to sustain the distance. So, for example, if you're a 400 meter runner or 800 meter runner or a marathon runner, you would definitely work on muscular endurance capacity. Another characteristics of, you know, another way of categorizing the sport according to the dominant skill set would be sport that are dominant in balance and coordination. So I know we've looked at gymnastics before, and it could be dominant in your body weight, but it's also dominant in balance and coordination. So it's how you control your body with exerting that strength or using your body weight through in a balanced and coordinated way.

So it's a combination of those two, right? So gymnasts need, as you can see in the picture, exceptional balance and coordination to perform their routines. So to perform intricate routines on different kinds of apparatus. So it could be a beam, you know, it could be your rings, it could be anything, right? So to perform these intricate routines, you need extreme exceptional balance and control along with muscular strength. So they should be able to carry a good body weight to precisely control their body movements or to optimize controlling or efficient control of. See how we're using the word efficiency again and again, it's extremely important that we don't spend extra energy or the energy expenditure doesn't go out of the deviated line and moves only towards the targeted line of where the body is aimed to go.

So it's extremely important we do that to reduce fatigue and again, reducing fatigue is reducing the risk of injury through controlled workload, right? So the efficiency is extremely important in this case as well. Another such example of balance and coordination would be for skaters, right? So constantly in skateboarding, you would see that when you're doing these different tricks and maneuvers, they need to have a good balance, so good core and good coordination to be able to perform their trick or their maneuver successfully. So they need strong balance and coordination skills. You need to have your routine that looks at muscles being able to stabilize the body through those particular range of motion to perform their different maneuvers while maintaining stability and control on the board, right? So these are the two examples we've looked at which is

gymnastics and skateboarding, both completely different, both requiring other non-dominant skill sets as well. But balance and coordination is their dominant skill set.

Another dominant skill set would be team coordination and communication. Now we know that there are a lot of group sport, right? So for football, basketball, volleyball, netball, you know, what else? There's doubles as well when it comes to tennis and badminton. So all of these require team coordination and communication, right? So let's look at basketball as an example. So players must coordinate not only their communication but their movements as well because they make, so if you're in a particular position, for example, in basketball, you might have the advantage to score the shot, right? So you need to have coordinated movement patterns and need to be able to effectively communicate with your colleagues to execute the any offensive or defensive strategies. So you need to execute all of this for a good team success, right? Another example would be soccer, right? So soccer players must work together as a team where you demonstrate coordinated movements.

You understand, so what each of you are good at, how the movements are being executed, which position are you at to be able to make those informed decisions and strategies, right? To have your plays. So we've looked at dominant skill sets and how we can categorize sport based on what's the underlying dominant skill set. Let's look at movement. So when it comes to movement, we've previously looked at the different subcategories.

Let's look at them one by one. So sport could be single-movement dominant, right? So single movement dominance can occur, for example, in javelin, right? So as you can see here in a picture, it involves one single explosive movement, right? And what's the aim here? It's to propel this javelin to as long as distance that you can achieve, right? So as far as possible. Now in order to do that, in order to achieve that distance through that explosive movement, of course, you need a good technique, right? So you need precision that will be generated by good technique to achieve your optimal throw. Now, what would what are some of the biomechanical characteristics or some of the requirements that you would need for javelin? Of course, we look at it in the next module. But let's look at some of the important ones, right? Like, what's the release angle? Once again, based on your trajectory mechanics, you need to also look at javelin trajectory.

Oops, just do that again. Right, so javelin trajectory kinematics. So what speed was it left? Right, so what speed was it released at, at the angle? What was the release angle? The position of the javelin athlete as well. So all of that is extremely important. So all of those are biomechanical considerations that you would consider to achieve good technique for precision and to achieve distance. Another such example of movement dominance would be for repetitive movements, right? So, for repetitive movements, for example, in swimming, so you repeat the same stroke over and over again over a distance, right? So

for example, if it's a 50 meters, you would repeat it for 50 meters and so, along with your turns.

So, in swimming, they need to repeatedly perform the strokes over a distance as we've looked at to show consistent and efficient arm movements. So it's extremely important that you're consistent, keep increasing the pace, you maintain the pace based on what your distance is and what your strategy is. And along with that, you also need to look at the rhythmic and the breathing patterns that supplement your technique and your strategy. Now, this is important to maintain speed and endurance as well. So if you're doing, if you're a long distance swimmer, you need to have good control over your breathing so you're not getting fatigued quite soon along with efficient movement patterns as well to maintain good speed and endurance.

So this is a classic example of where movements repeat over time. Another such example would be in cycling, right? So again, you're repeating the pedaling motions over and over again for the distance that you're covering. You need to optimize cadence, right? So cadence and power output needs to be optimized in such scenarios to maintain high speeds throughout the race. Hence, you need to keep repeating the pedaling motion. So for example, to look at the efficiency over here, when it comes to repetitive movements, it's important for us to understand what is causing that movement, what's the technique behind it, how do we achieve it once and what's the strategy to continuously keep on achieving it, right? Another movement dominance would be a combination of movements, right? So we've looked at single movement dominance, so something like a javelin or a shot put.

We've looked at repetition of movements. So, for example, swimming, where you keep repeating it again and again or in cycling. But golf, for example, has combination of movements, right? So it depends on what the distance is that you're trying to achieve. So if it's like a five-meter distance or a 10-meter distance, or you're going for a long shot, your movement then is going to change. Of course, your basic fundamental skill is probably going to be the same, but you're going to make slight changes to your release angle, to the speed of the club, the speed of the swing, you know, the speed of rotation and the speed of the ball that you're hitting.

It's the gut, sorry, the club speed. So the golfers utilize a consistent swing technique for each swing, right? However, there's a variation in club angle as we spoke about. The posture for sure, depending on what direction you're going for, so you would have a different posture. Force application, transmission, generation, all of that changes based again on the needs and the distance, and the direction of the target. So all of these things need to be considered. So it's a combination of movements to achieve adaptability and precision for a successful outcome.

Right, so another example of combination of movements is in archery, right? So although your basic skill would still remain the same, you would need to adjust your apparatus, right? So, the bowstring and the arrow direction based on the environmental conditions in this case. So the skill of drawing and releasing the bowstring, that remains constant, right? So the overall generic skill. However, you might have to adjust your body posture, right? And you might have to adjust the aim that you're going for, depending on the wind speed that day maybe, or, you know, depending on the weather, right? Or depending on the accurate lighting, timing of the day. All of that is to achieve accurate targeting, right? So this is, these are combination of movements, right? Two examples there.

Right. Another category that we could look at in movement dominance is based on incoming target. Now these movements are not set in stone, right? So they depend on what's or how are the characteristics of the incoming target. So one such example, as you can see in the picture, is baseball batting, right? You could also look at cricket batting, for example. So you need, so the athlete needs to then adjust your stance, your swing, you know, your direction, body posture, position, all of these things, depending on the incoming trajectory of the shot. So it could be the height of the ball, it could be the spin on the ball, right? So all of this depends on the incoming pitch.

So your trajectory kinematics and the speed of the pitch would warrant a change in the stance and swing. So variable movements in such case are effective to contact the ball and to hit it successfully, right? So your biomechanics or your technique have slight changes or massive changes depending on the incoming target. So, as we looked at, another example would be cricket batting, right? So cricket batters again adapt their stance and stroke based on the type of delivery. So it's a fast bowler, a spin bowler, a mid-paced bowler. Depending on the type of delivery, the cricket batsman then goes for a shot selection, right? It also depends now where your fielders are present, right? So to achieve maximum runs or to score maximum runs based on the field of play and the incoming trajectory, the cricket batsman have to adjust to their stance and stroke.

So when you're developing, for example, baseball batters or cricket batters, you would consider training them in different situational scenarios, right? For them to be versatile or to develop a diverse skill set to achieve these different, you know, successful outcomes when there are changes in the incoming target. So these help you, or they help develop decision-making skills, and they help you do dynamic adjustments as well, right? To hit the ball effectively. So now that we've looked at sports characteristics and the biomechanical characteristics of different sport and how you can categorize them, let's look at some of the implications, right? So why would all of these be important? How does it help us? So to understand the movement characteristics, of course, gives us a deeper understanding into coordination of different body segments. So how do we coordinate? How is the transmission happening? So, application of force and transfer of momentum as we've looked at in the cricket bowling, you would need to transfer that linear momentum

that you have developed during the run-up into efficient angular momentum. So for you to understand the needs of the sport and the movement characteristics that involve coordination of body segments and the application and transmission of forces helps you train your athletes better or coach your athletes better.

It's also the timing of muscle activation, right? So depending on the sequence of when these body segments become primary, you'll have different timing of muscle activation as well. And also acceleration and deceleration patterns. So these are some of the major ones. Of course, you have quite a lot of other biomechanical principles, but these are some of the major or the major highlighted ones over here. You can also look at their acceleration and deceleration patterns, right? So what we've looked at in today's module, we've looked at needs analysis.

So biomechanical performance analysis in sport involves the understanding and the application of mathematical and mechanical principles to understand and optimize movement performance. Now we do that by understanding needs analysis, right? Of what is the requirement of that sport. And these processes also require knowledge and understanding of appropriate tools. What are the tools? What are the techniques? The statistical approaches to understand movement and to analyze movement, right? And then we looked at these diverse skill sets are required in various sport to provide a foundational understanding, right? So we've looked at movement dominance-based, we've looked at dominant skill set based, how sport can be then broken down into your fundamental blocks so that you can have your athlete to be versatile enough across those range reserve requirements. That's it. Thank you.