

Jumping Mechanics – Projectile Motion

Author(s): Tim Worden, PhD

Original publication date: 2020

First appearing in: Horse Network <https://horsenetwork.com/2020/02/qa-how-can-you-tell-if-a-horse-has-scope/>

If you spend much time around jumping horses you will hear the term ‘scope’ used frequently. It is a general term used to describe a horse’s potential to jump big jumps. But what separates a scopey horse from a less impressive horse?

The more scope a horse has, the higher and wider the horse can raise its’ body into the air, and thus the bigger the course it has the potential to jump – assuming it is well trained and rideable.

A horse and rider jumping a 5* class is a beautiful thing to watch. It is incredibly complex when you consider that a horse and rider must work in harmony, while simultaneously controlling their individual neuromuscular systems, perception of the course, and so on. At the same time, the act of jumping can be viewed as relatively simple since it is governed by four parameters that predict the jumping outcome – the same variables that determine how far a soccer ball flies when you kick it or how far an arrow will travel when released from a bow. If you can optimize these parameters of projectile motion, then your horse’s ‘scope’ will be maximized. These four parameters are:

- 1) Speed at takeoff
- 2) Angle at takeoff
- 3) Height at takeoff
- 4) Air Resistance

Speed at takeoff

The horse’s speed at takeoff is the most important variable, as it will have the largest effect on how scope a horse displays. If two horses are the same height (e.g. 16.2 h) and leave the ground at the same angle, then whichever horse is travelling faster will jump higher and wider. Imagine hitting a golf ball – the harder you hit the ball the greater the speed of the ball when it leaves the face of the golf club and the further it will travel.

However, it is important to remember that if the speed is too fast in the ring it becomes difficult for the horse and rider to control, the takeoff angle will lower, and the horse will jump flat and lower the height of the jumps.

Key Point

Horses that are tighter with their legs (i.e. bring their legs closer to their body in the air) do not need to raise their body as high into the air to clear a jump as compared to horses that hang their legs. That is why jumping technique with tight legs is preferable – these horses need to generate less speed at takeoff as compared to horses with legs that hang in the air.

Angle at takeoff

The combination of vertical speed (lift) that the horse generates at the base of the jump and the horizontal speed the horse carries on approach to the jump will determine the angle at takeoff. Quality horses are innately able to modulate their takeoff angle depending on the circumstance, for example increasing their takeoff angle to clear a vertical set as the out of a tight combination. It is also critical that the rider provide the horse with the proper cues and supports the horse on approach so that it can set the proper takeoff angle.

Key Point

It takes a large amount of force at the base of a jump for a horse to convert the horizontal speed that it is carrying on approach into vertical speed (lift). As a horse becomes fatigued, especially later in the course, the musculature of the front end may become so tired that the horse is no longer able to push against the ground and rotate the body back to the hind end. Or the horse will begin to travel 'downhill' around the course. Without this rotation backward and loading of the powerful hind end, the takeoff angle will flatten and rails will occur.

Height at Takeoff

The next variable to consider is the height of the horse's body at takeoff. This depends on the horse's conformation and their body position at the base of the jump. If Horse A and Horse B both generate the same amount of speed and angle at takeoff, but Horse B's body at takeoff is 10 cm taller than Horse A's body, then Horse B will produce a 'scopier' jump than Horse A.

Key Point

While the standing height of a horse does play a role, how the horse moves its' body on approach to the fence is also important. What you will often see in a horse that lacks strength is a significant lowering of the body at the base of the jump in an attempt to generate more lift to clear the jump. While every horse must lower its' body to some extent at the base to jump, horses that lack strength will often lose their posture at the base of the jump –giving the appearance of 'collapsing' right before they load the hind end and jump up into the air.

Air Resistance

Under normal circumstances, the effect of air resistance on a horse and rider's jump is likely so small that it can be ignored. A strong breeze may have some impact on the horse and rider, but its' contribution to the overall jumping performance while the pair is in the air will be negligible.