

We Got Rhythm

The foundation of the training scale, explained in biomechanical terms

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THE TRAINING SCALE OR “pyramid of training” represents a logical framework for developing a dressage horse up through the levels. The first building block in the construction of a dressage horse is the establishment of rhythm. A simple definition of rhythm is that it describes the characteristic sequence of footfalls and phases of a gait (although other factors contribute to rhythm in the context of the training scale). In biomechanical terms, rhythm is defined as a *temporal* (timing) measurement that describes the number of distinct footfalls in each stride and the intervals between successive footfalls. Temporal characteristics are easily measured in a gait lab using slow-motion video replay to record the timing of the footfalls, from which the intervals between successive footfalls are calculated.

Generally, in a temporal analysis of a gait, the first thing we measure is stride duration, which is the time it takes for the horse to complete a single stride. From stride duration, we can calculate the tempo or stride rate, which indicates how many strides are completed per minute.

$$\text{Tempo in strides/minute} = \frac{60}{\text{stride duration in seconds}}$$

Tempo should not be confused with rhythm. Tempo is the rate of repetition of the strides; rhythm describes the timing of the footfalls within the strides. Average tempos for the gaits of dressage horses are:

Walk: 55 strides/min

Trot: 80 strides/min

Canter: 100 strides/min.

Interestingly, passage and piaffe have tempos that are almost identical to that of the walk (55 strides/minute), while the reinback has a similar or slightly slower tempo (average 50 strides/min).

It is easy to obtain an approximate measurement of a horse’s tempo using just a stopwatch. Simply count the number of strides he takes in one minute. Alternatively, count the strides for a fraction of a minute, then multiply by the appropriate number to determine the number of strides per minute (e.g., strides taken in 15 seconds $\times 4 =$ strides taken in 60 seconds).

The task of measuring the tempo of different gaits is facilitated by videotaping the horse, then counting the strides during playback.

Generally, after the tempo of a gait is determined, the next step is to time the footfalls, from which the gait’s rhythm and regularity can be deter-

mined. Again, rhythm is defined based on the number of footfalls per stride and the intervals between successive footfalls. The intervals between footfalls determine whether a gait is regular or irregular. (An irregular rhythm does not necessarily imply any fault or deficiency. Irregularity is a fault only when it is present in a gait that should have a regular rhythm.)

Rhythm of the Walk

The walk is a four-beat gait in which each hoof contacts the ground separately and distinctly. The walk footfalls occur in the following sequence: left hind, left front, right hind, right front (see Figure 1 below).

A four-beat walk performed at a tempo of 55 strides/minute has 220 footfalls/minute (4 footfalls/stride \times 55 strides/minute = 220 footfalls/minute).

Ideally, the footfalls of the walk are equally spaced so that the time lapse between successive footfalls is 0.27 second, or approximately one-quarter of a second. Figure 2 (next page) depicts this ideal.

When the walk footfalls are equally spaced, the walk is described as regular or “square.” ➤

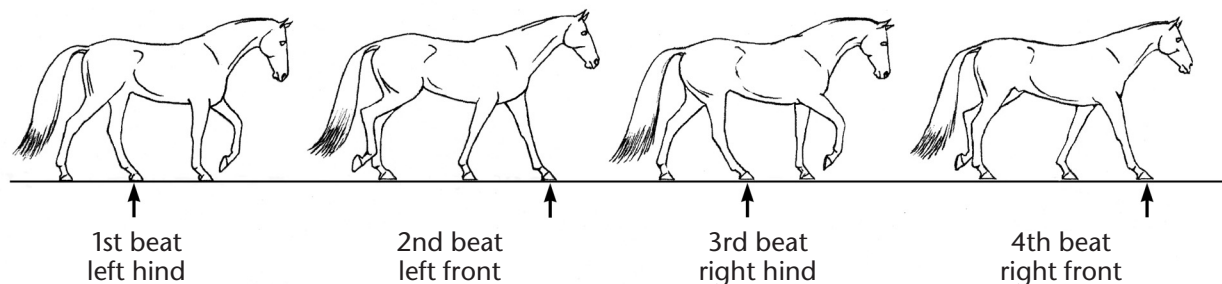


Figure 1. Footfalls in the walk

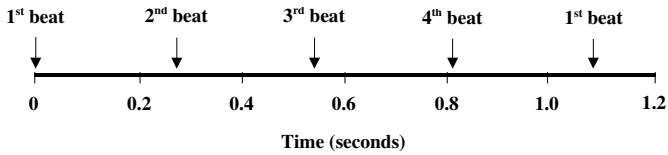


Figure 2. Equal spacing of footfalls in the walk produces the desired “regular” walk

Rhythm of the Trot

The trot is a two-beat gait in which the diagonal limb pairs move synchronously (see Figure 3, below left). The passage, piaffe, and reinback are also two-beat gaits, but they differ from the trot in tempo, stride length, and, in the case of the reinback, the direction of movement.

Slow-motion analysis frequently reveals a short dissociation in which the rear limb touches down a fraction of a second before the corresponding diagonal front limb (a phenomenon known as diagonal advanced placement and generally considered to be a sign of a good and balanced mover who’s using his hind legs well) in these gaits. However, this dissociation is not perceptible in real time (without slow-motion replay), and so the gaits are described as having two beats.

If a horse trots with a tempo of 80 strides/minute, there are 160 footfalls/minute, and the interval between successive footfalls is 0.375 second (see Figure 4, above right). The intervals between successive footfalls are equal in duration, meaning that the trot has a regular rhythm.

Rhythm of the Canter

The canter is a three-beat gait, with one diagonal pair of limbs moving synchronously. When a horse canters on the left lead, his left hind and right front legs are synchronized. In the right-lead canter, the right hind and left front pair move together. The first beat of the canter stride is the trailing hind limb; the second beat is the leading hind and trailing front diagonal pair; and the third beat is the leading front limb (see Figure 5, below right).

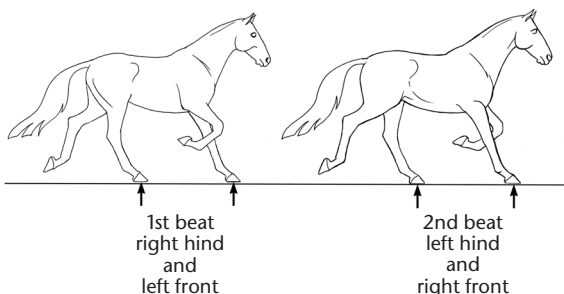


Figure 3. Sequence and timing of footfalls in the trot

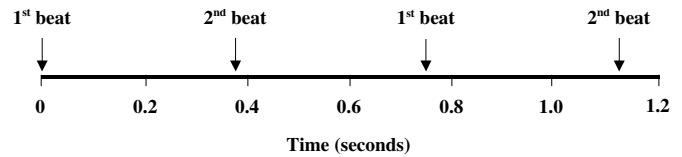


Figure 4. Timing of footfalls in the trot

In the canter, the time between the first and second footfalls and between the second and third footfalls is approximately equal, although the first interval is usually slightly shorter than the second interval. There is then a longer interval before the first footfall of the next stride (Figure 6, next page).

Because the time intervals between successive footfalls in the canter are not all the same, the rhythm is classified as irregular. As I explained earlier, “irregular” in this sense does not imply a faulty rhythm; it is an inherent and normal feature of the canter. The term *regularly irregular* is sometimes used to describe the canter, meaning that, although the rhythm is irregular, it should remain the same from stride to stride.

The walk, trot, passage, piaffe, and reinback each should have a regular rhythm, with equal time intervals between successive footfalls and the footfalls sounding like beats of a metronome. In these gaits, any rhythmic irregularity is a fault that will be penalized by a judge in dressage competition.

Many horses show an irregular rhythm in the walk. The most common irregularity is that the interval from hind to front footfall is shorter than the interval from front to hind footfall. This is called a *pacing* or lateral rhythm. If you look back at Figure 2, a pacing rhythm would be shown by relatively short intervals between the first and second footfalls and between the third and fourth footfalls, with longer intervals between the second and third and the fourth and first footfalls.

For a gait to be considered “pure,” the tempo and rhythm should be consistent from stride to stride. Variations in rhythm are considered a serious fault in dressage. They are often a sign of tension in the horse (or rider).

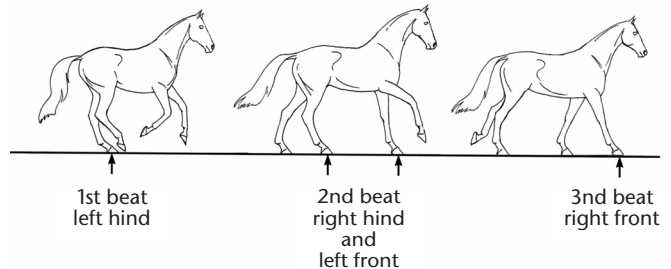


Figure 5. Footfall sequence and timing of footfalls in the right-lead canter

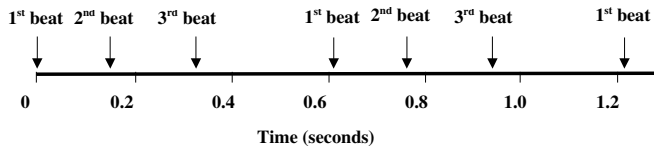


Figure 6. Timing of footfalls in the canter

Level and Even

Evaluation of the rhythm of a horse's strides also encompasses other qualities of the gaits and movements, such as relaxation, cadence, levelness, and stride evenness. The techniques of gait analysis can be used to measure the levelness and evenness of the movements. These are linear (distance), measurements, in contrast to the temporal nature of rhythm, per se.

Evenness describes the relative lengths of the left and right steps. In the walk, trot, passage, piaffe, and reinback, the steps should be the same length. Unevenness of the steps may arise as a result of unequal muscular strength on the left and right sides of the body or of mild lameness. It may also be a manifestation of "rein lameness," meaning an asymmetry or restriction of the gait that is not the result of a true physical lameness. The term gets its name from one of the causes of the phenomenon: a rhythmic change in tension in the left and right reins.

The steps are described as level when the left and right limbs are raised to equal heights as they swing forward. The steps should be level in the walk, trot, passage, piaffe, and reinback. Unlevel steps may be a sign of inequality in muscular strength, restriction of movement due to an old injury, pain during movement as the result of arthritis or other lameness, or reinlameness.

An understanding of the biomechanics of rhythm and tempo gives new insight into these important qualities of movement. With careful observa-

tion, you can learn to be more perceptive in your observations of your horse's locomotor patterns and improve your skills in detecting gait problems. ▲

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This month's column is excerpted from Dr. Clayton's lecture on biomechanics at the 2003 USDF National Convention & Symposium in Dallas.

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