



Title:	Learning to race 5.0 Braking – slowing down to go faster
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Objectives:	To instruct the rider on the reasons for using brakes, how to use brakes in racing, and how to achieve the best lap times using brakes.
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Goals:	Effective and safe braking for racing.
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Subject:	<ol style="list-style-type: none"> 1. Reasons for braking 2. Initiating braking, applying the brakes, revision 3. Adjusting speed to appropriate speed for the corner 4. Releasing the brakes 5. Braking zones 6. Rear brake 7. Throttle blip for gear shifting 8. Maintaining body position and form 9. The 'leg dangle'
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Procedures	Classroom instruction, one-on-one discussion, group discussion, on-track instruction, video demonstration
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Technique	One on one discussions demonstrating braking actions, on-track demonstrations, video of racers in action.
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Most Common Mistakes	Not understanding correct reasons for braking, poor brake control, braking too early, too much, too long.
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Summary	<p>Most riders believe that the brakes on their motorcycle are there to slow them down. In the context of racing, this is not entirely correct.</p> <p>The real reason for using the brakes is to set the appropriate speed of the motorcycle for the corner that is being negotiated.</p> <p>Brakes are an integral part of controlling the stability of the motorcycle, while at the same time, the rider will be selecting the appropriate gear for the corner and corner exit.</p> <p>Understanding the real reasons for using brakes in racing is an important, if subtle, distinction. If the rider is thinking only about slowing down, the rider will do just that, slow down. However, if the rider is thinking primarily about finding the optimal speed for the corner, then the rider will achieve the highest possible speed for the corner, and therefore faster lap times.</p>
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Remembering that the less time spent using the brakes, and more time using the throttle, the lower will be the lap-time.

Braking must also be done progressively by squeezing, rather than 'grabbing' the brake levers. If braking is too snatchy or too aggressive, the bike will pitch up and down too much, causing the suspension and the tyres to overwork and possibly lead to a loss of control.

If braking is progressive (both on applying and releasing the brakes) the suspension and tyres will load and then unload in a controlled progressive manner allowing the tyres to maintain contact with the road and maintain control.

Progressive braking allows you to feel your way into the corner and feel the grip of the front tyre. Riders should learn to 'load' the brakes just prior to the corner (by applying the brake just a touch) so that they can then apply them progressively.

Early on in a career the majority of braking should be done before you reach the corner. This allows you to maintain your concentration on each aspect as it arrives (ie braking, then turning, then cornering etc). As your experience develops your understanding, feel and rhythm will improve and you can start allowing your braking to move further into the corner (trail-braking).

Braking is not all done with the front brake. The rear brake is also an important source of chassis balance and rear wheel control as demonstrated in photo with the overlaid graph.

The majority of the braking effort is generated by the front brakes, but the rear brake plays a very important role in settling the motorcycle chassis and controlling the geometry while in the corner.

Braking occurs in five steps:

- 1) Initiation
- 2) Braking
- 3) Rear brake
- 4) Brake modulation
- 5) Brake release

Initiation:

As the rider approaches the point on their racing line at which they have decided they will use the brakes to set their speed for the corner, the rider should squeeze very slightly the front brake lever. This initiates the process of weight transfer into the front suspension and the front tyre. It is sub-optimal for the weight transfer to occur all at once as a result of 'grabbing' the brake lever.



Grabbing the brakes transfers the weight or loads up the suspension and front tyre very rapidly and can result in loss of control. Hence the reason for initiating the braking prior to the main braking point.

Braking:

At the decided braking point (one of your reference points), the front brake lever is squeezed increasingly harder until the rider has decided the speed is appropriate for the corner. If the rider then wants to release the brakes they can do so. If however, the rider needs to continue braking while in the corner, ie trail-braking, the rider can release slightly the brake lever while maintain some pressure on the lever.

Trail-braking is an important, but advanced, technique for decreasing radius corners and is a technique that requires significant practice until it can be done safely and effectively. The front suspension of the motorcycle needs to be well set with good dive control for this technique to be effective.

Drill: While pushing bike in straight line and walking alongside the bike, have rider apply front brake. Want rider to be able to do this steadily and under control, not grabbing and jerking to a stop.

Brake modulation:

It is not necessary that once the brake is applied, that the same braking effort (braking pressure) is maintained throughout the braking sequence. Riders can modulate the braking effort by releasing and applying slightly the brakes throughout the corner. Brake modulation allows the rider to change the racing line while in the corner as the bike will stand-up or lean over more depending on how the brake is modulated.

Brake release:

The brakes must not be released all at once. If the suspension is poorly set, the weight can transfer away from the front end of the motorcycle too quickly and the front tyre can lose traction and cause loss of control. It is important to release the brake lever in a swift and smooth but not immediate action.

Braking zones:

When approaching the corner entry and the corner itself, the rider will apply different amounts of brake pressure. The image below demonstrates the different braking zones.

Fingers:

The number of fingers a rider will use on the brake lever will depend on several features: their hand/finger size, their strength, the quality of the brakes, personal preference. Some riders on some bikes are able to use only two fingers to get full braking effort, some riders on some bike require all four fingers and still struggle



to get full braking effort. This shows that significant practice must go in to the skill of braking itself, and then braking for racing.

Rear brake:

Use of the rear brake is a vital skill that must be learned early by new and young riders. If they do not learn it early, they will struggle in later years.

The rear brake is used to balance the braking effort of the motorcycle, it is used to help settle the chassis while in the corner, to help bring the bike back to the line should it begin to run wide of the desired racing line and it can be used as an analogue traction control when exiting corners with lots of throttle, speed and lean angle.

The rear brake is usually applied using the foot lever, however, left hand mounted thumb-brake actuators are becoming more popular and available.

Throttle blip for gear shifting:

If the rider shifts down gears without changing the speed of the engine to match the new gear, they run the risk of the rear wheel locking up or exhibiting extreme engine braking effect and possibly hopping up and down. Therefore, an important technique to avoid this and to ensure smooth downshifts on corner entry is that of throttle blipping.

As the rider squeezes the front brake lever and prepares to shift to a lower gear, the rider will pull in the clutch lever, twist their wrist rapidly to 'blip' the throttle, then shift gear and release the clutch. This must all be done very rapidly to achieve the desired effect.

The need for throttle blipping for downshifting is reduced if the racing motorcycle has a 'slipper clutch' fitted. The slipper clutch negates the excessive engine braking effect.

Riders can now see that the braking and corner entry activity has all of a sudden become very complex.

Remember: Engines and transmissions are NOT brakes! Brakes are for going slower. Engines and transmissions are for going faster!

Maintaining form and body position:

If rider watch old video of races from some years ago, or riders who have been racing for many years, they will see the riders push their bodies up out of the racing crouch as they brake, and sometimes those riders will have straight arms and legs and knees will be thrust out into the wind like a sail.



It is important that new riders and racers do not develop these habits and styles of riding. Pushing the body up out of the racing tuck and extending to straight arms causes all of the riders' body weight, in addition to the weight of the motorcycle, to be transferred into the front end and front suspension of the bike. This increases significantly the work that the front suspension and the front tyre must do to maintain control under braking. Thrusting the leg out upsets the bike balance and locks riders into a position.

It is also important for rider to not allow their body to slide forwards in the seat to an extreme degree while braking. Ensuring that body weight is kept in the middle of the seat as much as possible helps reduce forward weight transfer and pitching of the bike, this is achieved by gripping the tank with knees.

It is therefore important for young and new riders to develop the habits where they maintain as much as is possible their racing tuck, maintain a bend at the elbow in the arms and keep body weight from sliding forwards, while braking.

Clearly the rider must lift their head and body somewhat to balance themselves, but it is surprising how little is needed, especially at low speeds on smaller bikes as riders begin racing.

Maintaining bent arms allows some of the riders' body weight to be controlled by a secondary 'spring', so to speak, in the riders' elbows, should a sudden bump or harder braking be encountered or needed.

The rider can mitigate body weight sliding forwards by gripping the fuel tank of the bike between their knees, until it is time to enter the corner.

The leg-dangle:

Anyone watching GP and SBK racing over the past few years will have seen riders dangling their leg out to the side of the bike while braking. This is one of the modern technique developments that has caught on with riders at the very top of their game. Indeed, very recently we have started seeing riders take both feet off the footpegs, but this seems quite extreme!

Use of the leg-dangle is very much down to the rider to develop if they want to or not. Not all top-level riders use the leg-dangle, but it is very much a feature of contemporary motorcycle road-racing at high levels.

The leg-dangle helps the rider balance their weight on the motorcycle if they have decided they will try to slide the rear wheel while braking. It also helps the rider feel more 'loose' on the bike and allows the bike to move around more rather than being always tightly under control and 'stiff' on the bike.

There are aspects to the leg-dangle that riders can manipulate and personalise for their own style, and also for the type of corner.



For example, we see riders riding around a long fast corner in one direction (eg right hand corner), while approaching a slower left hand corner, throwing the left leg way out from the bike. This helps the rider get the bike turning from one direction to the other but moving a small bit of mass towards the left side of the bike.

Some riders are now experimenting with not dangling the leg so far out when cornering (ie when approaching a slow corner, not in the situation above, but a more regular corner), but rather leaving the leg much closer to the bike when dangling down. This seems to work better with small bikes (eg Moto3), while riders of the larger and heavier bikes (eg SBK, MotoGP, Moto2) we see the leg further out from the bike.

Some riders will also drag their foot (boot) on the ground while entering the corner, before bringing it back to the footpeg. Be aware, that this technique does wear out boots!



Assessment Sheet
Learning to race 5.0
Braking - slowing down to go faster

Item	Pass/Fail	Comment
Understanding the reason for using brakes and how they should be used		
Good control of front brake		
Good control of rear brake		
Clear and good control using both brakes together while entering corners		
Use of rear brake while in mid-corner to control racing line		
Trail-braking and brake modulation		
Keeping good body form and position while braking and releasing brakes		
Developing the leg-dangle, if rider wants to. Understanding reasons for using the leg-dangle		

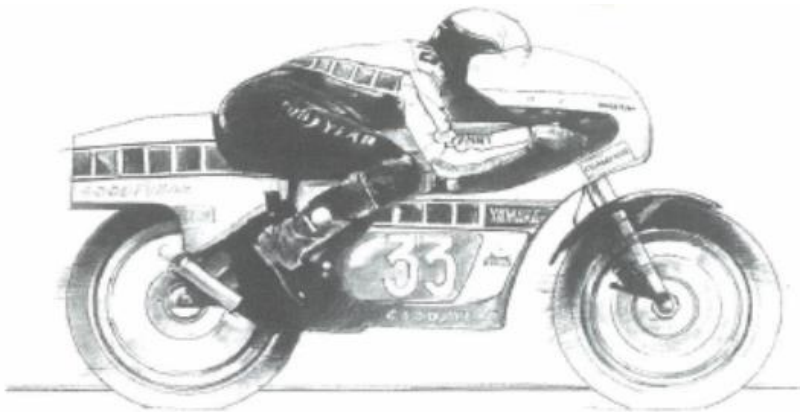


Overall Comments:

Guardian/Student Signature:

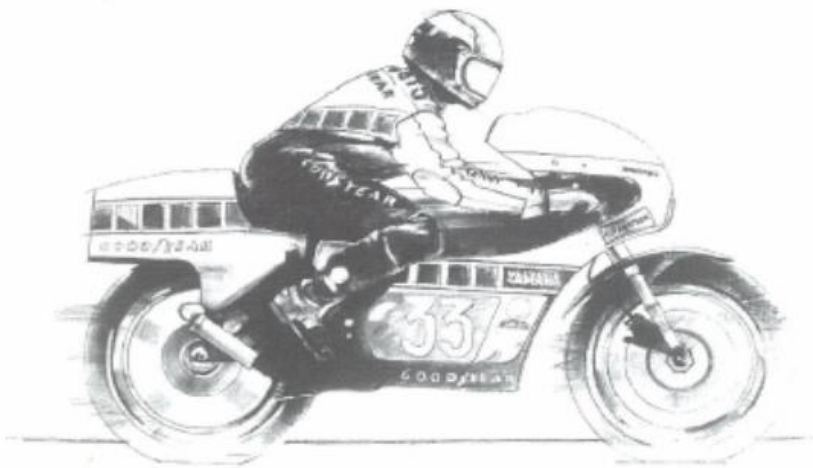
Trainer Signature:

Date:



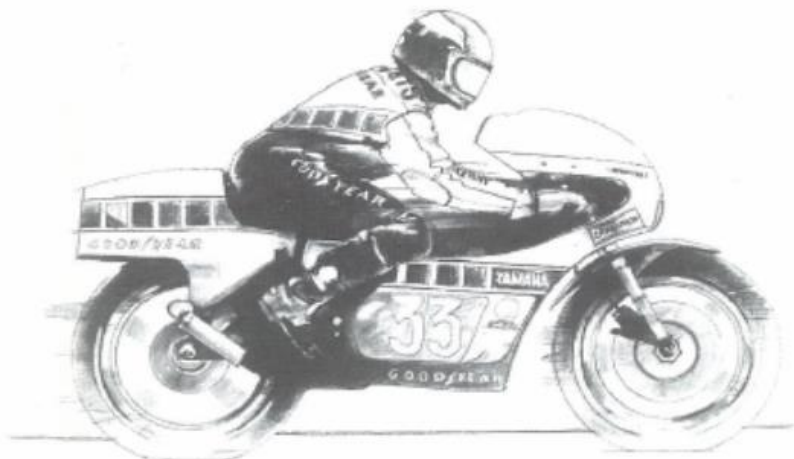
Rider in full racing tuck.

Weight balance 50%/50% front/rear.



Rider initiating braking.
Body in half-tuck, arms bent at elbows, knees gripping fuel tank.

Weight balance approximately 75%/25% front/rear.



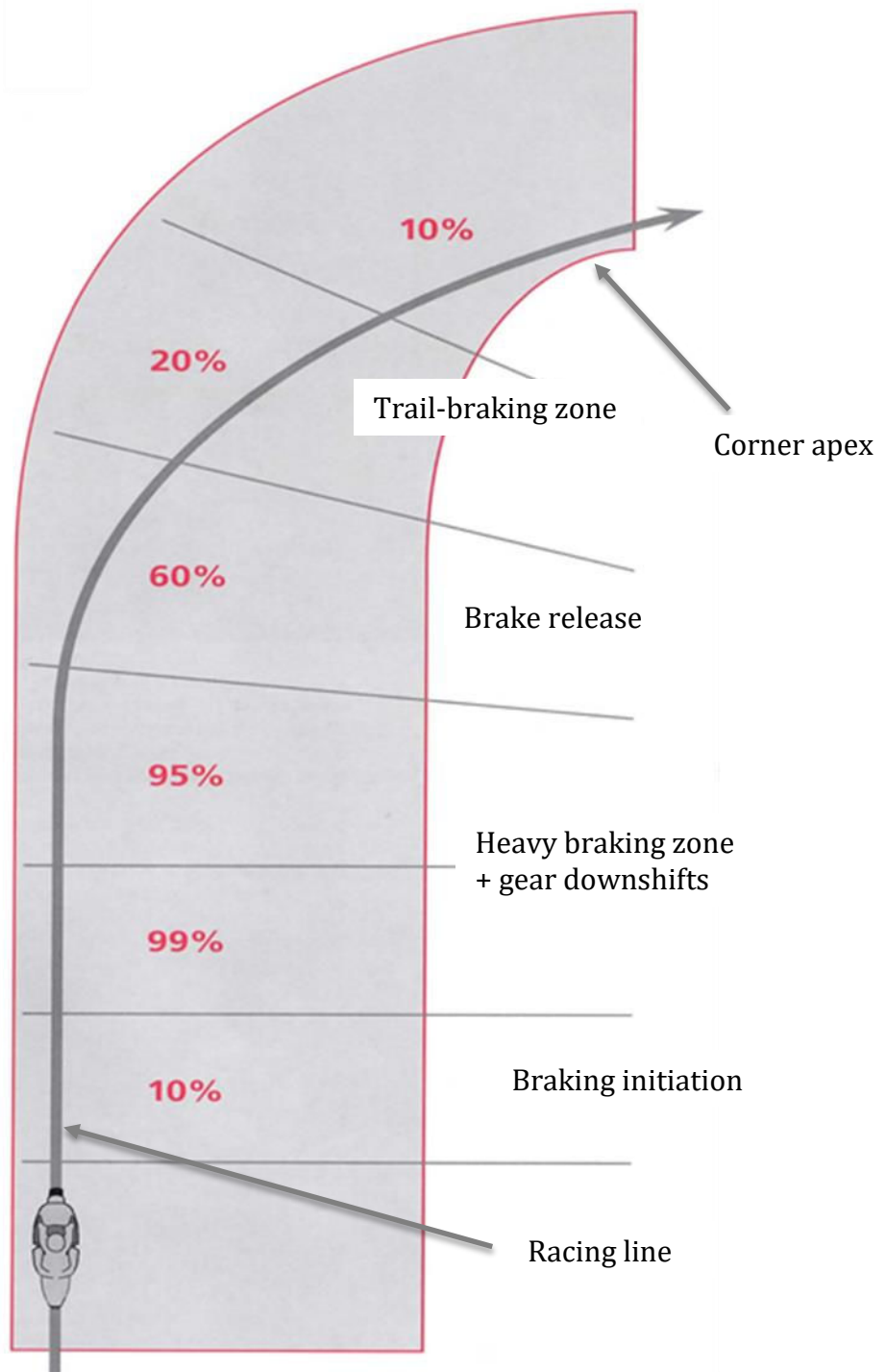
Rider in full braking.
Body maintaining half-tuck, arms still bent, knees still gripping fuel tank.

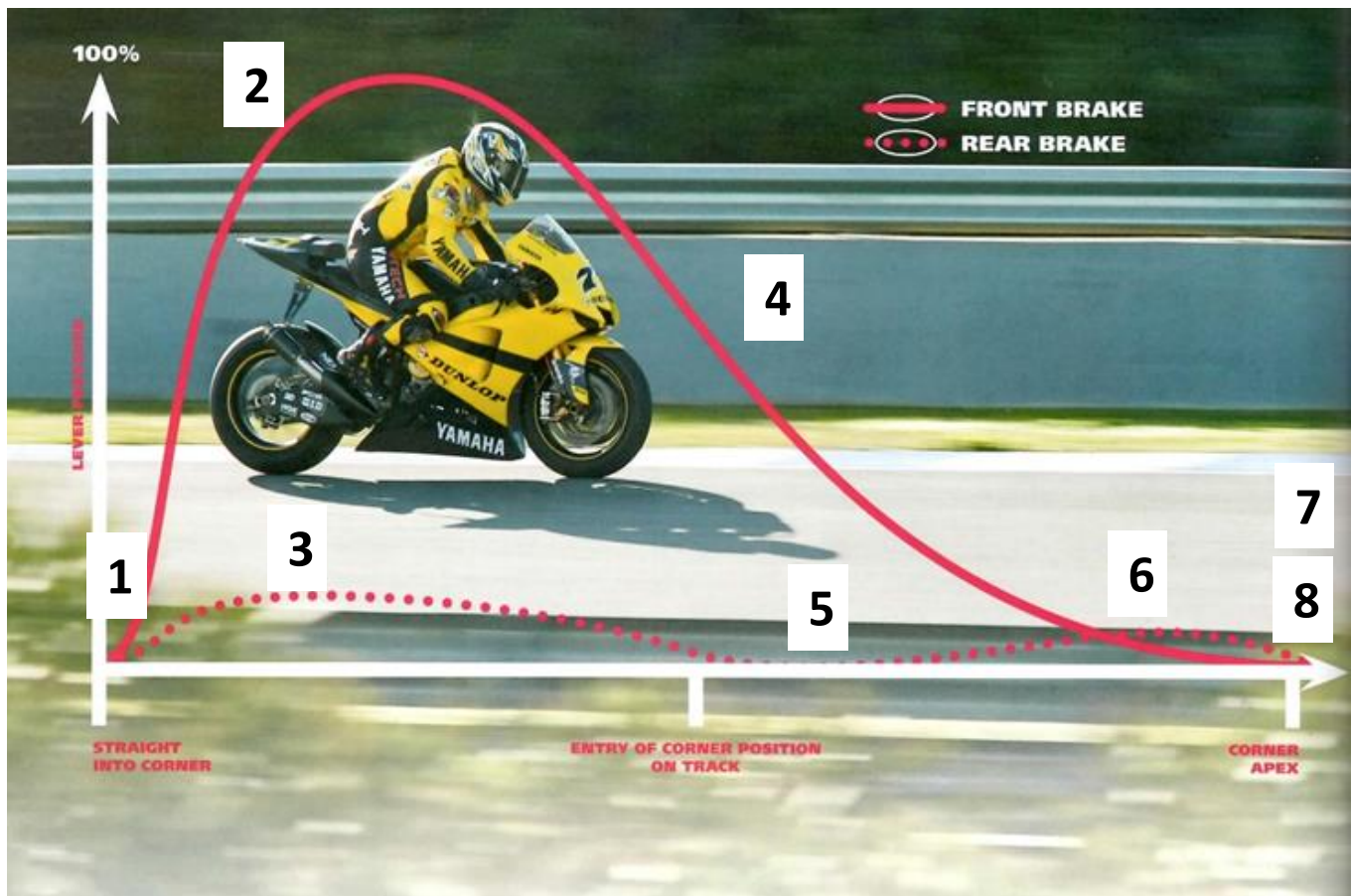
Weight balance approximately 95-100%/5-0% front/rear

**Engines are NOT brakes.
Transmissions are NOT brakes.
Engine/transmission = Go faster!
Brakes = Go slower!**

The corner entry and the corner are divided into zones of different braking effort. If the rider chooses to trail-brake in the corner, the diagram provides a guide to the amount of brake pressure the rider might apply in the corner and while leaned over in the corner.

The braking initiation is first, followed by the heavy braking zones, followed by the brake release and trail-braking.





Demonstrating braking technique:

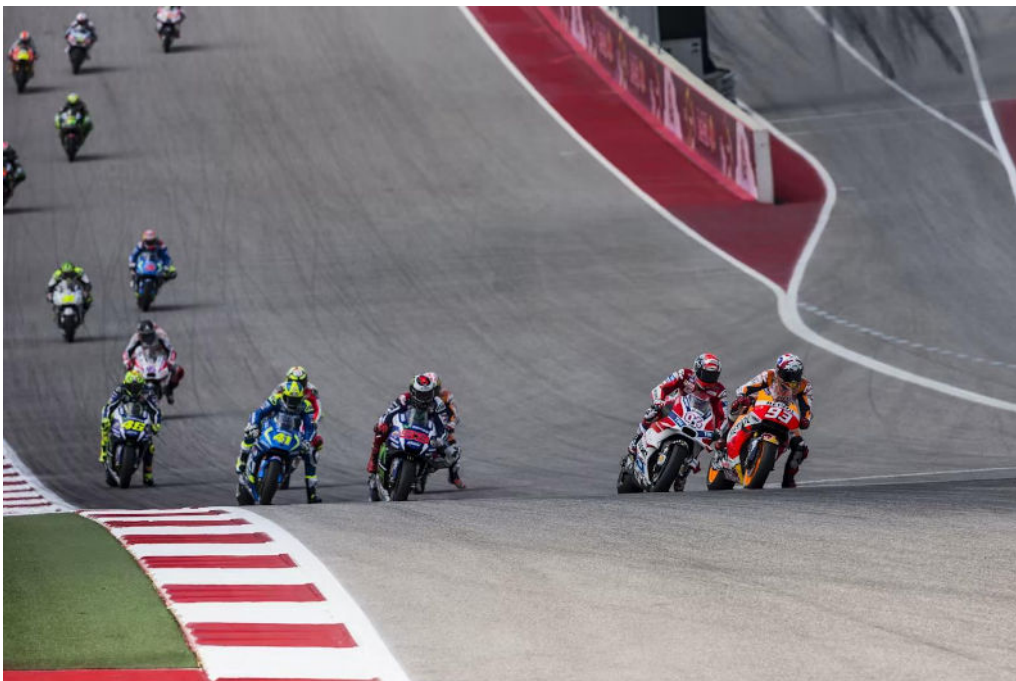
Following the graph from left to right, which shows braking effort vs distance into corner:

- 1) Braking initiation, smooth, not grabby
- 2) Maximum braking effort applied rapidly, but progressively
- 3) Rear brake applied to balance chassis pitching
- 4) Front brake release progressively, not rapidly, ie trail-braking
- 5) Rear brake modulated at corner entry
- 6) Rear brake re-applied to change racing line
- 7) Front brake released, steadily, not rapidly, fully at corner apex for corner exit
- 8) Rear brake released after front brake, at corner apex for corner exit, to maintain some chassis control and rear wheel-speed control

Note also that the rider has maintained some racing tuck, has not allowed his body to slide all the way forward, and has maintained bent arms throughout the braking procedure.



Two Rookies Cup riders demonstrating two different leg dangle techniques. Note also how riders' arms remain bent and bodies are not fully sitting up straight.



MotoGP riders demonstrating different leg dangle techniques and also how the leg positions might change at different parts of the corner. Note how far away from the corner that Valentino Rossi, #46, has started his leg dangle and how Jorge Lorenzo #99 does not use it.