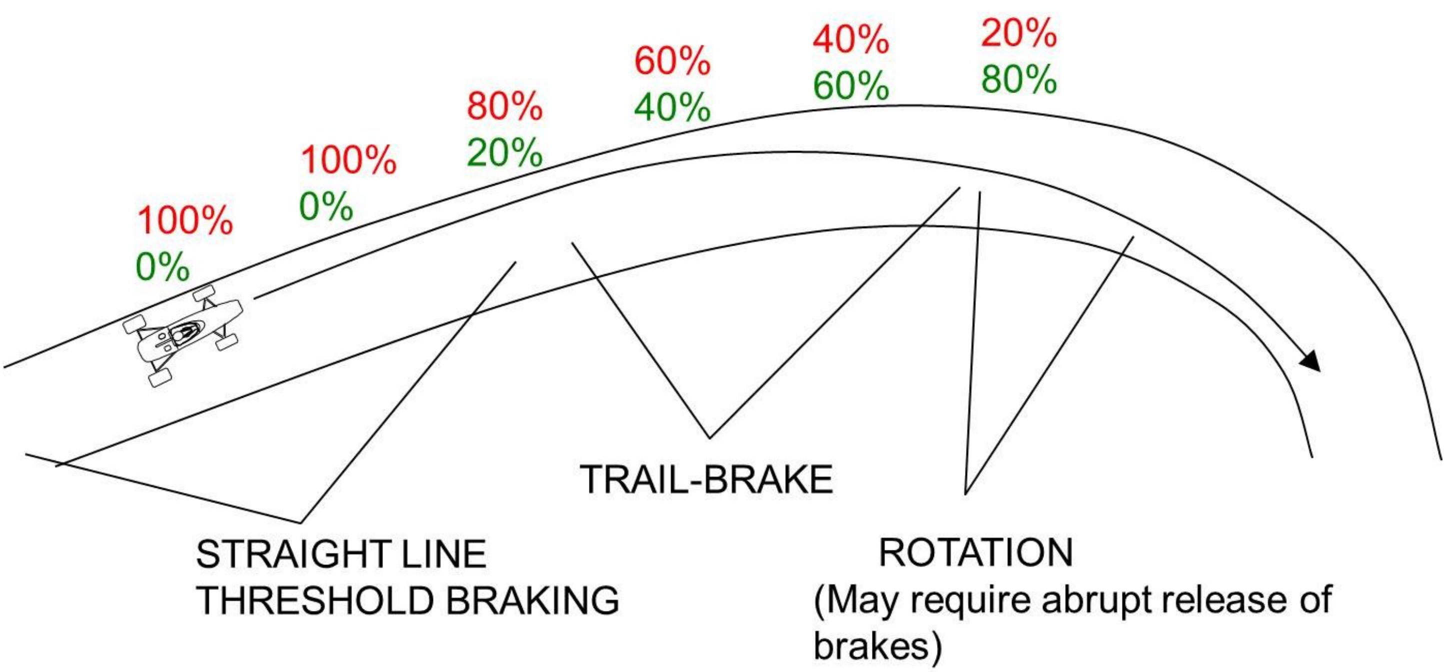
CORNER ENTRY ROTATION

By Ed Valpey

Before diving into this subject we need to put out a couple of disclaimers. First, the technique we're describing requires fairly strong car control skills. If somebody has never been on a skid pad, or hasn't been on one for a long time, they would be well advised to master those exercises before attempting this technique… and if somebody finds themselves on 13/13, or worse, as a result of reading this article they can't say they weren't warned. Second, the proper amount of rotation is very subtle and fairly difficult to detect. The slides, lines and steering angles used in the illustration are somewhat exaggerated for the purpose of clarity. From the perspective of an outside observer corner entry rotation is barely discernable and from the cockpit it's like walking a fence rail. We absolutely do not want you tossing your car into a corner like Travis Pastrana, which on a road course will both make you slow and increase the chances that you'll find yourself lawn-darted into a tire wall. Here's a simple litmus test: if in attempting this technique you repeatedly need to correct to keep from spinning the car, then you're getting it wrong and you're going to crash. Attend a skills school.

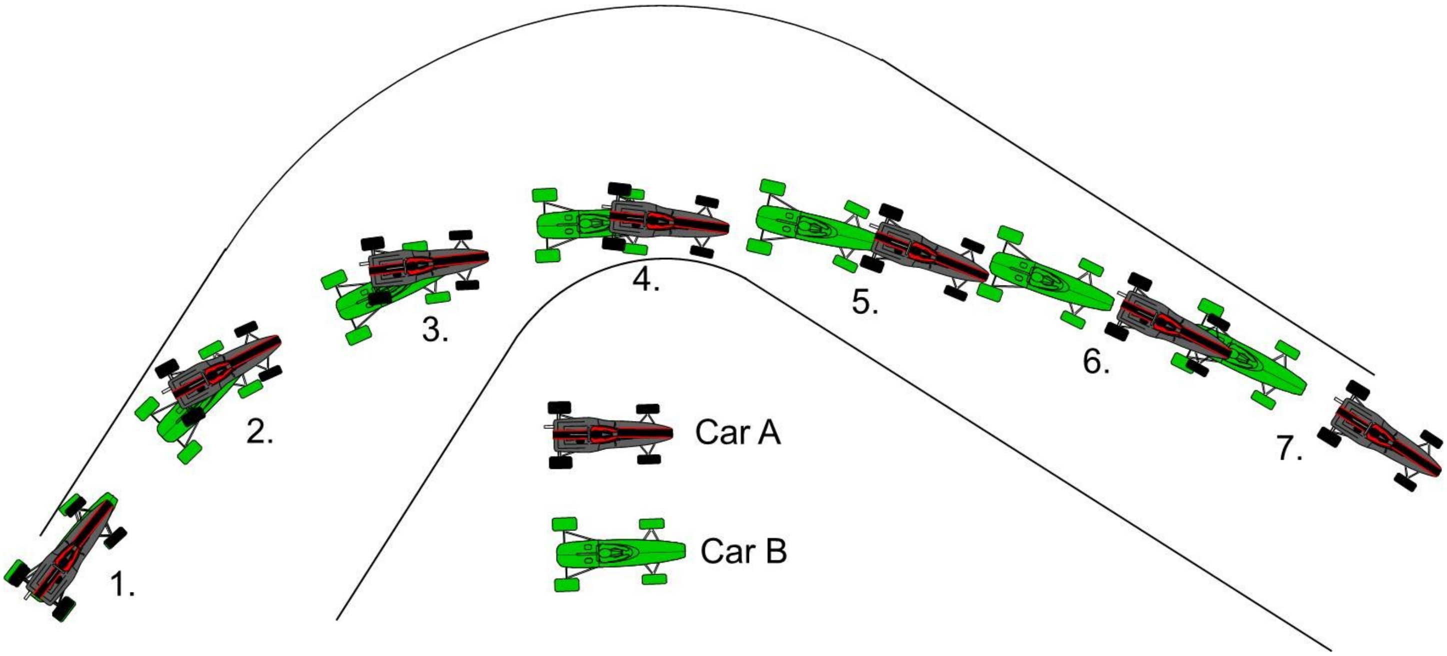
TRAIL-BRAKING

In order to rotate a car into a corner we must first be proficient at Trail-Braking, where we reduce brake pressure in proportion to increased steering input during corner entry. In the illustration below the percentage of tire traction being used for steering input in shown in green and the percentage being used for braking is shown in red.



A good way to think of this technique is to imagine a string with one end tied to the toe of our right foot (through pulleys in a Formula car) and the other end tied to the bottom of the steering wheel. As we turn the steering wheel, the string will pull our foot off of the brake pedal. Done properly, the string will neither stretch nor go slack. If the car is set up properly, this careful blending of inputs will cause the car to rotate. Some cars, on the other hand, need a little coaxing. In the portion of the illustration labeled "Rotation" we note that an abrupt release of brakes may be required. Our braking has loaded the front tires for optimum grip, but a portion of the tire's traction is still being used for braking. If we abruptly come off the brakes, the tire will immediately use that abandoned potential to turn the car even harder. It's short-lived, however, because releasing the brakes also causes weight to transfer back to the rear wheels, giving them better traction and making them less likely to slide. If this latter technique is required to make the car to rotate, it will likely happen immediately after we release the brakes or not at all.

CORNER ENTRY ROTATION



The above illustration shows two cars entering the same corner at the same time. Note that the two are cars are driving on the same line, with a late turn-in and an increasing radius exit path (the entry line, in fact, is a decreasing radius). Note also that the two cars' front tires are following nearly identical paths while their rear tires are following different paths during corner entry. The two cars have the same weight, the same cornering potential, the same gearing and the same horsepower (Car B has been made slightly larger for clarity). The only difference is that Car A is employing the "rotation" technique that we've mentioned in past articles. An underlying principle that we must keep in mind while dissecting this technique is that the traction potential of our tires is finite, whether we're using this potential for braking, turning or accelerating, or for a combination of these things. When used in combination there is an inverse relationship between these inputs. If we use more tire potential for braking, for instance, we have less available for turning… the more steering input we have, the less throttle we can use. The technique of rotating a car on corner entry allows the driver of Car A to use less steering and brake input during corner entry, freeing that potential for use accelerating sooner out of the corner.

1. At the turn-in point the four contact patches of both cars are in the same place and the cars are neck-and-neck. The difference is that Car A is carrying a bit more speed.

2. Our speed is limited by the radius we're driving on and, closely related, the amount of steering we have to input. The driver of Car A has used the proper combination of braking and turning to create rotation, or yaw. The slip angles of the rear tires are larger than those of the front tires and the car has begun to slide into the corner. In this state, the car will continue to scrub speed even after the brakes have been released and, depending on the amount of yaw, the car will continue to turn even after steering input has been reduced or eliminated. It is, in other words, in the process of spinning. At this point the driver of Car A is no longer using brakes and his steering is being used to control the slide rather than actively steer the car, yet the car is still slowing and it is still turning. In fact, it's using the grip of all four tires to do so while the majority of this burden for Car B has been placed on the front tires only. Car B, relying mostly on the grip of his front tires, still has more steering to do and must have some brake input to slow his speed and keep the front tires loaded so that they will continue to turn.

3. For Car A the greatest degree of yaw is experienced well-prior to the apex. Here it's pointed well into the corner and the front tires have little or no steering input. In fact, if the car is "loose" the driver may even be counter-steering to a degree. This is the critical point in the corner, for the driver needs to stop the car from sliding or that slide will become a spin. He could do this with counter-steering, but a better option is to start adding power. With throttle input, weight is transferred to the rear tires and they get better grip… their greater slip angles are reduced and subsequently balanced with those of the front tires. Car B has slowed enough to make the turn so he can stop braking, but his car is still pointed out of the corner so he must maintain his steering input. If he goes to power at this point, he will unweight the front tires and diminish their cornering capabilities.

4. The driver of Car A is now in an optimal position for exiting the corner. Most of his turning is done and the car is pointed in a direction that will allow him to exit on an increasing radius. By this point the driver should be at full throttle and as the car accelerates it will seek a progressively larger radius. The driver doesn't unwind the steering, but instead holds his steering lock as the exit radius increases with acceleration. Car B is getting there, but is still pointed relatively more out of the corner and the driver cannot yet go aggressively to throttle. At this point in the turn Car A will begin to dramatically pull away.

5. The driver of Car A, which is at full throttle with a fixed steering input, isn't doing much other than watching his track-out point to be sure that his increasing speed/radius won't cause him to drop wheels at the exit. If he feels he might drop wheels, he simply needs to breathe off the throttle a bit to decrease or "tighten" his exit radius. The driver of Car B can now start to straighten his steering wheel and go to full throttle.

6. At this point both cars are in roughly the same condition… full throttle with sustained steering input. Car A, however, is a car length ahead and is carrying more speed.

7. At track-out Car A has gained more than a full car length and has, say, 3 mph more exit speed. That 3 mph will gain him 4.5 feet per second over Car B in the ensuing straight. If that straight lasts 10 seconds, Car A will be roughly 4 car lengths ahead when he goes to brakes for the next corner.