Intermediate Session: Finding Gains

- This presentation is targeted at solo blue and white run group drivers
  - All drivers should be able to consume this info
  - Most Techniques in here should be safe for Green and Yellow run group drivers
    - **Advise them to discuss with their instructor**
    - **Encourage them to work on things in priority order: Line, Exit, Entry, Late Braking**

- Some of the content started from Chuck Tucker's slides, at: http://community.hagerty.com/
  - Be sure to give Chuck a call out when presenting
  - Slides inspired by Chuck's are identified in the lower left of the slide
- These slides are intended to be 15-20 minutes of content, allowing for questions in a 30 minute session
- There are slides after the end of the presentation for those viewing these online

- These slides have copious speaker notes, which can be useful if you're viewing these online yourself.

Finding Gains

"As soon as you touch this limit, something happens, and you suddenly can go a little bit further. With your mind power, your determination, your instinct, and the experience as well, you can fly very high."

– *Ayrton Senna,* Three Time F1 World Champion

Already doing?

- Consistent line, use all the track
- Smooth inputs
- Gradual brake release
- Identify when offline, adjust accordingly
- Enough mid-corner speed: must stabilize car using throttle
- **Look ahead!**

This talk is about finding gains. That is, key places on the track where you can extract a little more speed and get slightly better lap times. Progress at the advanced level is the sum of many small improvements. And improvement that buys you a 10th of a second, that you can repeat each lap, is great progress. Find one of those in every turn and you're a second faster. And, we can probably find a few of these in every turn.

But, before you start looking for these small gains, make sure your driving using the things we see on these slides. Consistency, smoothness, understanding and adapting to being slightly offline (maybe taking a turn from the inside, following a pass). Being smooth and gradual on our brake release and traveling through a turn with enough speed that we have to be on the throttle a little, maintenance throttle, to balance the car.

How to Find Gains

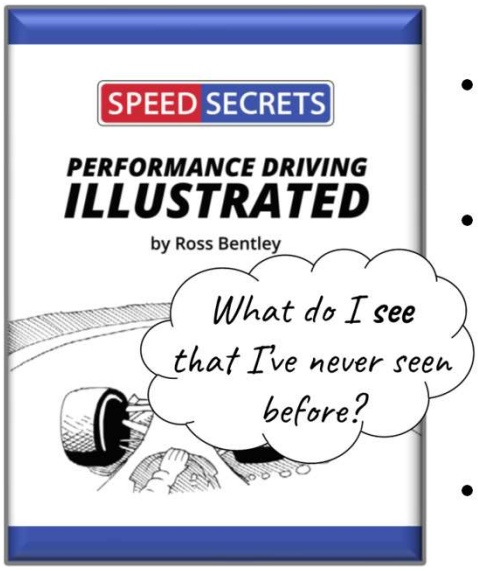
0. **First: Look Ahead!**
1. The Line
2. Maximizing Throttle
3. Higher Corner Entry Speed

Today, we're going to talk about three ways to find gains in your laps.

We'll briefly talk about the line, which may be review, but is really important. We'll talk about maximizing throttle in important places and about entering a turn with higher speed.

First, let's review vision and looking ahead.

Vision (Look Ahead)



- Performance Driving Illustrated:
  - 15% dedicated to vision and senses
- Tendency to stare: turn-in, EoB, Apex
  - **Especially when trying new things**
- Look "through the corner"
  - Blind turn? Can't see? Imagine.
- Constantly Scan: Look further ahead
  - Smooth process, not one done in steps

Looking ahead: We're all already doing this, but let's talk about it briefly, since it's so important, especially when you're trying new things.

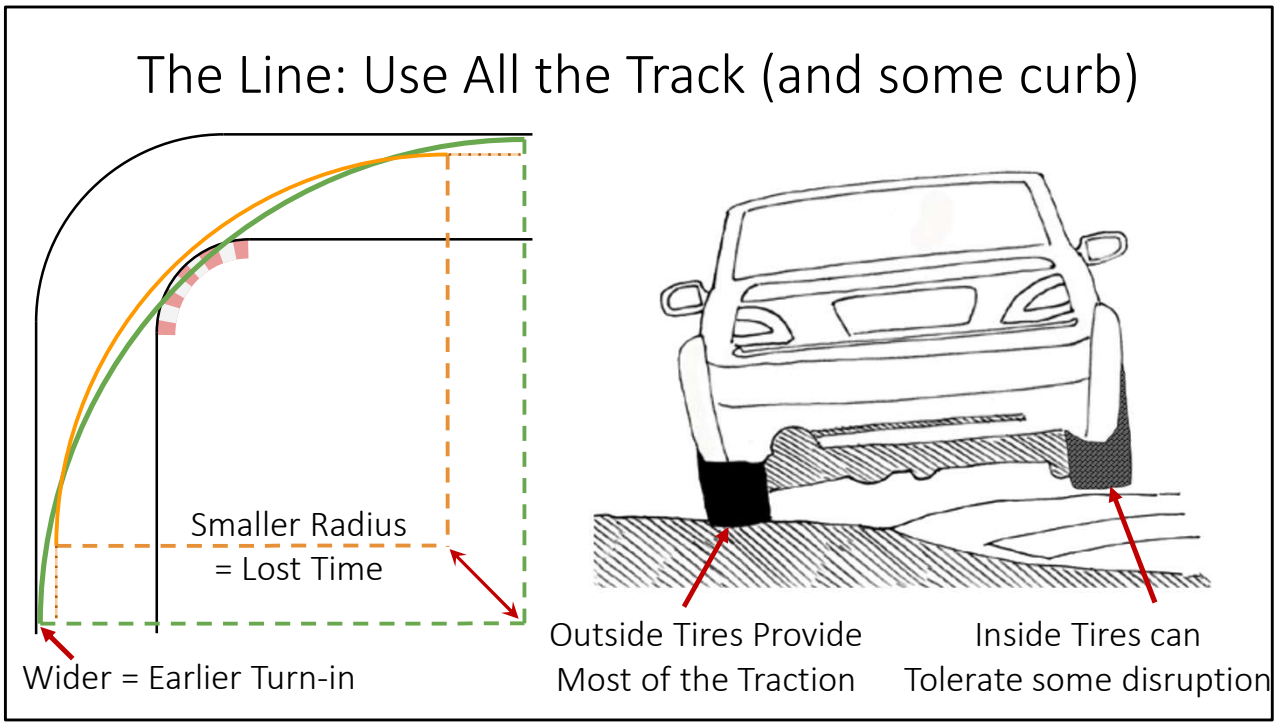
It's easy to find yourself staring at points in the track. Maybe you're trying a new turn-in or a different braking point… find it with your eyes, and then move your eyes to your next point. Be looking at the end-of-braking and apex when you're starting braking. Look past the apex as you're turning-in.

Really, we want to be looking as far ahead as we can and constantly scanning the entire landscape so we have a clear image of the track in our heads. And, if we can't see parts of the turn… imagine them.

Turn 6 at Palmer, at the top of the hill, imagine the apex and track out as you're turning-in.

Turn 5/6 at Thompson, under the bridge. Imagine the second apex as you're coming into the beginning of the turn.

Maybe turn 6 at Club Motorsports



Let's talk about using all the track. This is probably review for you. We even had this on the list of things we should already be doing. But, like with using your vision to always be looking ahead, it's worth emphasizing. Using all the track is one of the most important and easiest ways you can gain a little time in every corner. Giving up a foot here or there will show up in your lap times.

Unless you're navigating a series of connected turns that demand you make come compromise between turns or you're choosing a special line to take advantage of track nuances, such as camber, then you should always be at the outside of the track at turn in and always nailing your Apex at the inside of the track. A tire's width makes a difference.

Next time you're out there, analyze how wide you at turn-in are and how close you are at turn-in and apex. Be at the edge.

The same applies to track-out. The more width we use, the less we have to turn the wheel,

the more throttle we can apply and the faster we'll be. But, I'm calling out track-out separately, since it's worth noting that you can choose to give yourself a little breathing room on track-out, maybe a tire's width or 1 foot, for safety. Especially as you're learning a turn, or making changes to take a turn faster than you have been, plotting a line that leaves you a little room on the outside at track out, gives you a little space if you're coming out to the turn too hot. That last foot on the outside, may give you the space to keep it all contained. Doing this will be a little compromise on your speed/lap-times, and as you get more comfortable with the turn, and the changes you're making, you can start narrowing that gap on track-out and get back that time.

This safety margin doesn't really apply at turn-in or apex. Use up all the track there.

In fact, you can usually use the apex curb on the inside. Drive right over it! You can do this with some curbs, in some cars. Some curbs are so big that they'll disturb any car and need to be avoided. Other curbs are lower and cars with stiffer suspensions, with good rebound, can drive right over many of them without a disruption.

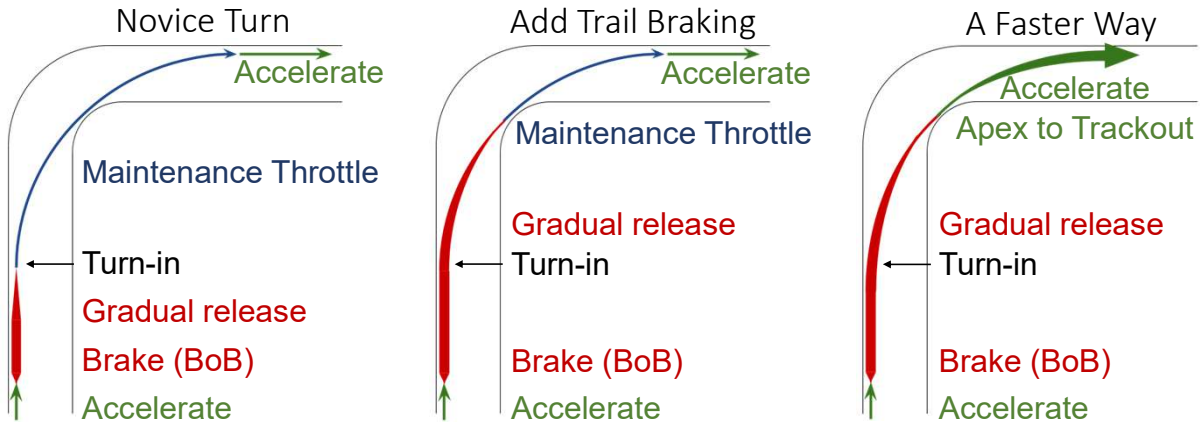
If doing this lets us change the radius of our turn by a foot or two, we'll likely see higher speeds and lower lap times.

A key thing to consider is where the weight of the car is when you're at Apex. Which tires have most of the load?

The outside tires. At apex, most of the weight is on the two outside tires, and it will usually be fairly well balanced from front to back. You're probably already on the throttle, likely for balance, maybe a little acceleration, but the car should feel pretty stable. We're relying on the outside tires for most of our traction and the inside tires are carrying a lot less weight and contributing a less to our overall traction. So, it's often no problem that they're bouncing over a curb. We don't need them much.

Maximize Throttle: Apex to Track-out

- In a turn, where do we get on the throttle?
- Where do we start accelerating?



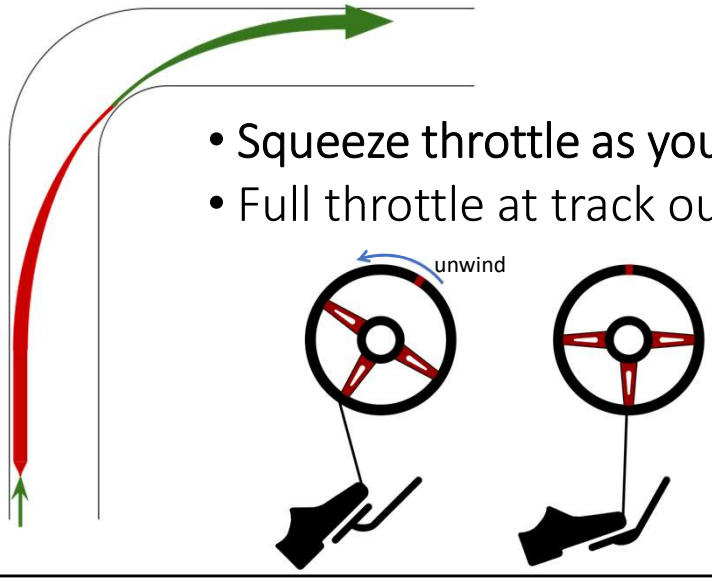
Here we ask, when do we get on the throttle?

When do we start accelerating?

Many of you are probably already driving like the image on the right. We want to be on the throttle a bit at the apex; "maintenance throttle" for balance. Often you might pick up maintenance throttle just before the apex, and then squeezing on the throttle and accelerating at or just after the apex.

If you find yourself accelerating a lot before the apex, you probably over-slowed. For some turns, due to camber or elevation changes from turn-in to apex, maybe you need to slow more and then accelerate before the apex. But for most turns, we should be decelerating most of the way to the apex, using balance or maintenance throttle around the apex… and then: Squeezing on the throttle, accelerating, from apex to track-out. Full throttle by track-out.

A Faster Way: Accelerate from Apex to Track-out



There is a connection between our throttle and our steering. We want to be gradually unwinding the wheel, starting at the apex and continuing until the wheel is straight at track-out, and squeezing on more and more throttle as the wheel straightens.

We don't want to turn the wheel, hold it turned all the way through the turn to track-out, and then abruptly straighten it. Our hands and our foot should be connected. Gradually open our hands, or unwind the wheel, and in concert, gradually squeeze on the throttle.

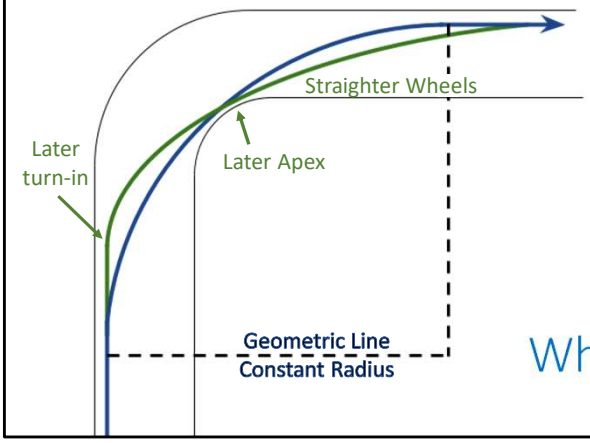
When I'm doing this, I'm not actually thinking about a direct connection between my hands and foot, or between the steering wheel and the pedal, but it's a good way to understand things. What I am thinking about is feeling the weight of the car transfer from the outside tires, as I unwind, back to being balanced left and right. My eyes are up, I'm looking ahead, and this guides the unwinding of my wheel. As I feel the weight shifting, I squeeze on the throttle.

We want to apply as much throttle as we can, at each point from the apex to track out, without losing traction or requiring some sort of correction. By the time you're at track-out, your wheels should be straight, and you should be at full throttle. For many cars with moderate horsepower, you can likely be at full throttle before track-out.

DB0

More about the Line

- Geometric Line vs "Ideal" Line
- Ideal: Allows earliest throttle application



- Most turns: Late Apex
- Straighter wheel means:
  - **More throttle**
  - More speed at track out

Which turns are most important?

Geometric line focuses on keeping a stable speed throughout the corner by having the largest radius possible with a constant arch throughout the turn.
The geometric line is the best way to utilize the entire track and carry the most speed through a corner (keeping a consistent pace throughout the corner). This may be the fastest path from your turn-in to track-out, but the geometric line is generally not the fastest driving line.
An important goal is to have the most speed at track-out, as you're entering the straight (short or long) after the turn.
A Good Apex, or the "Ideal" line, is one that allows the earliest throttle application while unwinding the steering wheel (without later needing a steering correction) resulting in the highest speed at track-out.
The Apex is the inner most point of your driving line through the arc of your turn. It's the point that separates your corner entry from corner exit.
We don't want to be be accelerating a lot while we're still turning in… that likely means we over slowed. We want to decelerate to the apex and accelerate from the apex, building to full throttle by track-out. Straighter wheels allow for more throttle and more acceleration.

For most turns, a line with a later turn-in than the geometric line, and a late apex will let you get the wheel straighter sooner, allowing more throttle and more corner exit

speed.

Taking a late turn-in like this will require you to slow more than the geometric line. Look how much the car is turning at the beginning of the green line. This is where trail braking and leveraging the benefit of rotation to adjust your angle can really help. Rotation: Turning the car without turning the wheel as much.

The diagram here is not to say that the fastest line for every turn will look like this. This diagram is over emphasizing the late turn-in so that we can clearly see how much straighter the wheels are.

Every turn has so many nuances. Camber, Elevation, track surface and grip, combination of turns (e.g., throw-away turns). The important idea to take away is the goal of maximizing corner exit speed and the idea that having straighter wheels sooner will allow sooner and more throttle application.

Maybe, based on your line, track camber near the apex or other things, you're on the throttle even just before the apex. That's OK if that's what the turn calls for.

Which turns are most important? Turns leading onto the longest straight are almost always most important, but sometimes the highest speed turns themselves offer the best opportunity for improvement

Slide 9

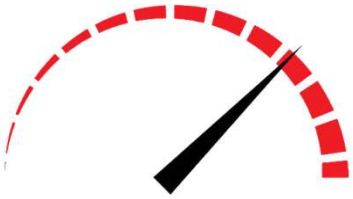
DB0 Do you want to have some notes to answer the question about which turns are most important? The turn before the longest straight and what's important is to get on the gas early so maybe a later apex is good in this case.

David Berman, 2023-04-28T20:42:56.733

TC0 0 The speaker notes proved a the specific answer to the question: “turns before longest straights”. The notes don’t expand on this and repeat the point about caring as much speed out of the turn onto the straight. I think the presented can can repeat that if it seems like the audience needs it.

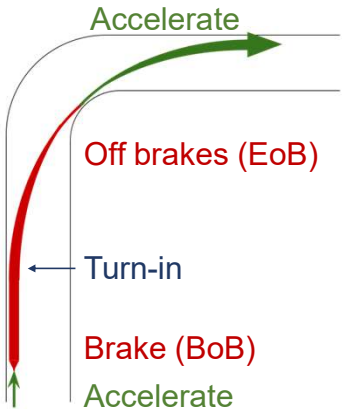
Tim Canfield, 2023-04-28T21:01:39.477

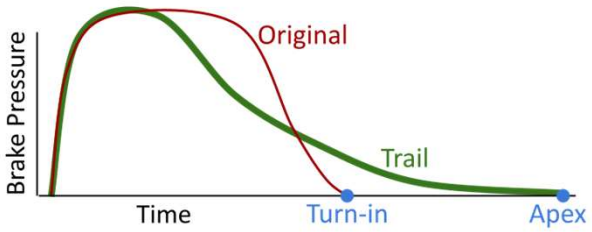
More about the Throttle



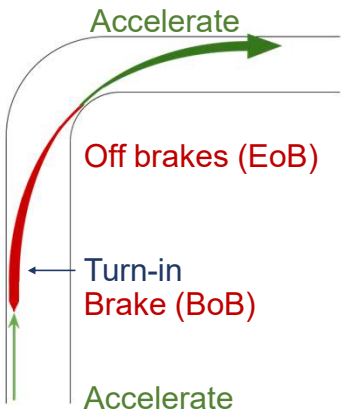
- **Stay on throttle until braking**
  - Don't coast to your braking point
- **Get to full throttle as often as possible**
  - In between two close turns?
  - A second is great; half-second is worthwhile

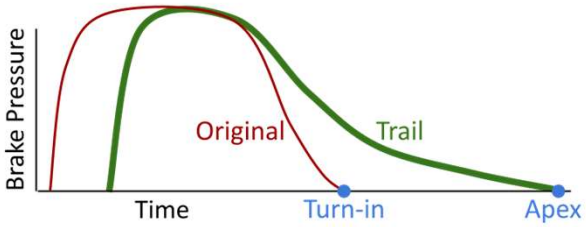
Higher Corner Entry Speed
Trail Braking Review





Higher Corner Entry Speed
Later BoB





Make Every Practice Session Count

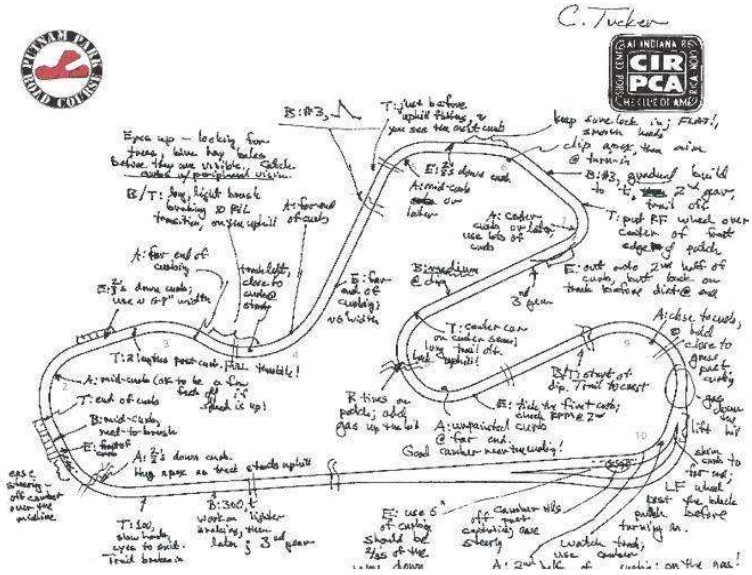
- Work on 1 or 2 specific goals each track session

  Priorities:
  1. Line
  2. Corner Exit
  3. Corner Entry
  4. Late Braking

- Compromise other parts of your lap to work on your goals
- Practice deliberately, add speed incrementally
- After each session, debrief:
  - What worked? What didn't?
  - Goals for next session?

Use track maps to save what you learned

- braking point (B)
- turn-in (T)
- apex (A)
- exit (E)
- curbs
- crests of hills
- bottoms of dips
- marks on track
- places to look
- flag stations



The mental game is so important. If you said to me "I don't think I can do that" my response to you would be "then you are right" because if you think you can't, you can't.

- Ross Bentley

End of Presentation

Extra Slides &
Reference Material Follow

Further Reading

- High Performance Driving Magazine : Nailing the Apex
- Ross Bentley, Speed Secrets: Performance Driving Illustrated
- TheDrive.com: Easy Ways to Drop Lap Times
- NASASpeed.news: How to Rotate a Car
- NNJR Interview: Dennis Macchio from Monticello Motor Club (video)
- KangaMotorsports.com: 10 Tips for Faster Laps and 5 More Tips
- Focus: The Mental Game of Driving.

Develop a high-performance brain

- Recognize when you are losing focus or judging yourself
  - Use a key phrase to refocus (e.g., **"Eyes up, look ahead"**)
- Mistakes offer us learning opportunities
  - Keep your mistakes small and single
  - Acknowledge the mistake and continue driving fast. Don't dwell.
- Convert self-judgments into learning goals
  - Instead of thinking "I'm bad at . . .", think "I'm working on . . ."
  - Then figure out **how** you'll work on that skill
- Fear is real: acknowledge it
  - Driving is an intellectual sport; as we get better, fear goes down

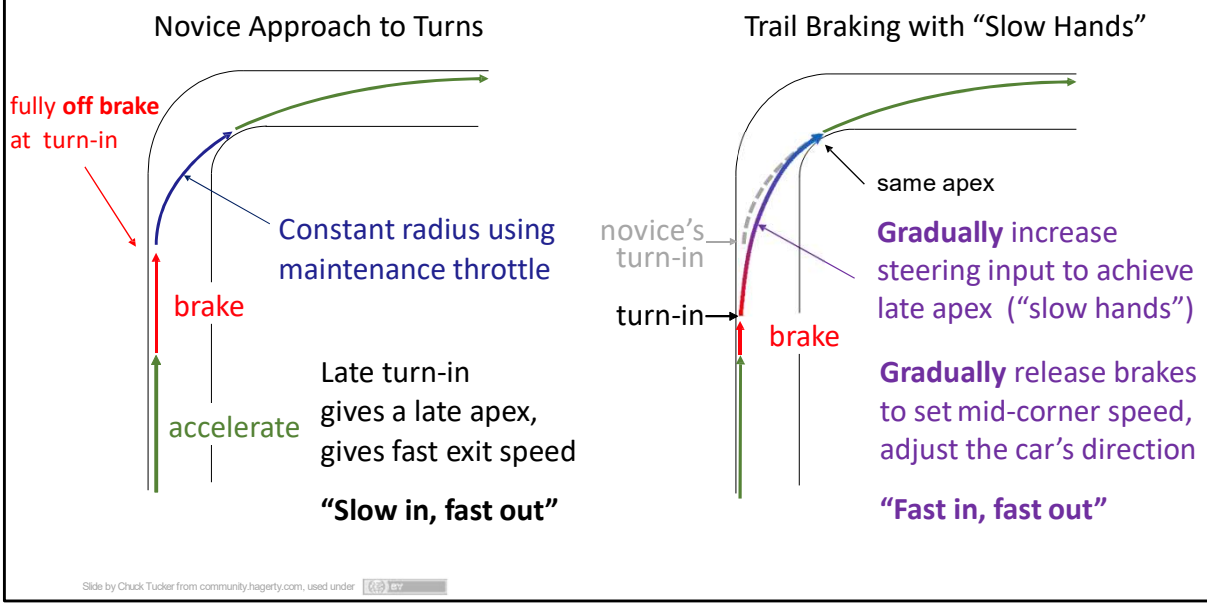
Use mental imagery to train your brain

- Close your eyes and imagine yourself executing the skill
- Move your hands, feet, head, etc.
- Add as much detail as possible: sights, sounds, g-forces, . . .

- Cheap, and **very** effective

- Keep skills sharp between track weekends
- Lock in progress from your on-track practice sessions
- Get yourself ready to work on a new skill

Trail Braking, Earlier Turn-in, and "Slow Hands"

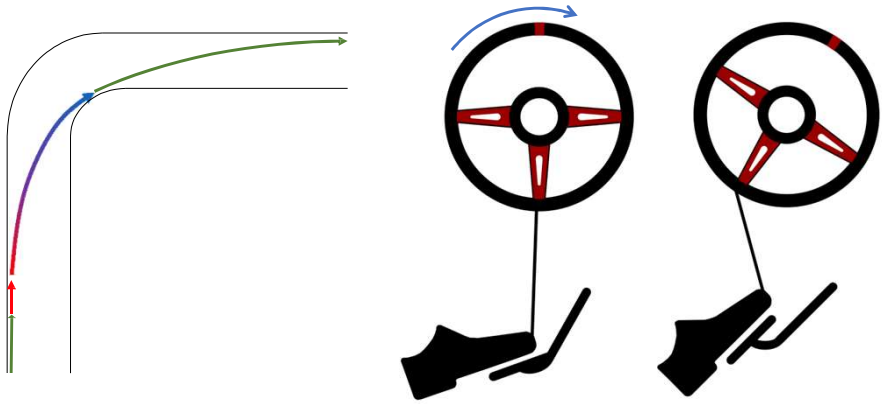


Slide 20

jc0 these diagrams show the proper acceleration out of a turn. Good slide
john canfield, 2023-04-26T11:56:17.994

DB0 0 Same comment as before. The color pasts the apex should be green indicating acceleration.
David Berman, 2023-04-28T20:09:49.034

Turning and Braking



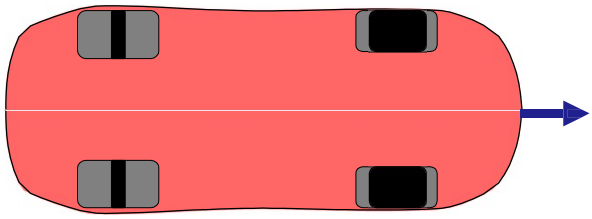
- Your foot and your hands are connected
- As you turn the wheel, release the pedal
- Smooth connected inputs

•"Friction Circle" and "String Theory"

•Tires can only do 100% of one thing: braking, cornering, or acceleration.
•If you release the brake pedal quickly before turning into a corner, there will be a time when the tires are not being used to their full capabilities.
•As you turn into a corner and you need 10% of the tires' grip to turn the car, you can only use 90% for braking; then you'll ease off the brake to 50%, giving 50% to be used for cornering; then 25% for braking and 75% for cornering; and eventually 0% for braking and 100% for cornering. This is generally referred to as the "100% tire rule."
•The "string theory": Imagine a string tied from the bottom of the steering wheel to the top of the brake pedal. When the driver is braking hard, the string is tight and the steering wheel is pulled straight; as the driver begins to turn into a corner, the string will pull up on the brake pedal, easing the pressure off of the brakes; when the steering wheel is turned fully for the corner, the brakes cannot and should not be applied at all. Of course, this theory should also be applied to the application of the throttle, but for this document, we're focusing on the braking and corner entry portion of the track.

Two Reasons for Trail Braking

- Helps use all front traction = better turn-in
- Keeps load on front tires = better rotation



Trail braking is about adjusting the balance and changing direction of the car.
- Ross Bentley

Note that this slide <u>doesn't say</u>:
- Trail braking is about slowing down
- Trail braking is how you brake as late as possible

Maybe those points are true, but they are not the main focus of trail braking. Ross Bentley has a short article on these points: https://speedsecrets.com/braking-its-what-separates-the-best-from-the-rest/

Ross says, trail braking is about "changing the balance of the car. Changing the direction of the car."

Bullet 1: Trail braking helps with turn-in
- Trail braking helps you use all of the front tires' traction in the corner
    - and minimize or eliminate understeer
- If you don't trail brake, and suddenly take your foot off the brake pedal as you turn-in, there will be a fraction of a moment when you are not using all of the front tires' traction
    - That means the tires will have to work hard to turn
    - (and it means you could have been carrying a little more speed)

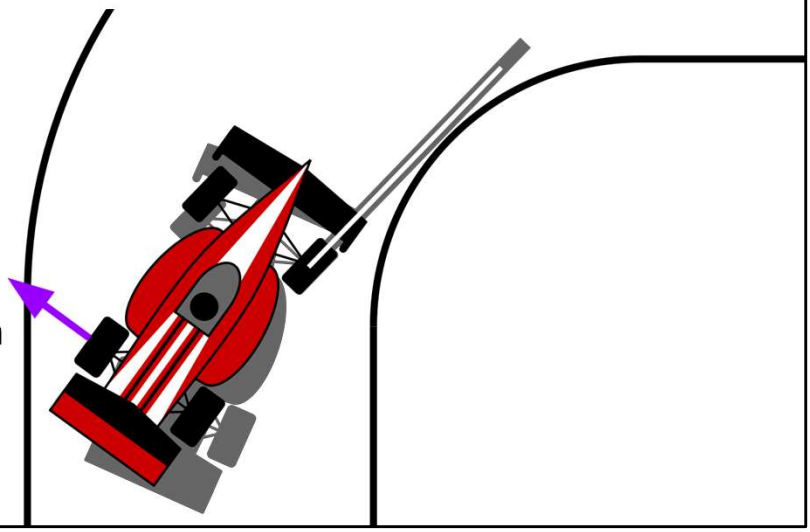
Bullet 2: Trail braking helps with rotation

- Trail braking deeper into the corner, keeps load on the front tires so, which helps the car “rotate”
    - the car will turn into the corner with less steering input
    - it will change direction more easily.

Rotation of the Car

- Rotation: Turning car with less steering
- More weight up front = less weight in back = less rear grip
- Rear tires slide a little to the outside
  - Points car toward apex
    - Straighter steering
    - More throttle
    - Greater apex speed

Car turns using rotation
- With less steering



Rotation vs Oversteer?

What does it mean that "trail braking helps with rotation?" When we're trail braking, we're keeping more weight up front. This means the front tires will have more grip than when the car is in a neutral or balanced stance, and the rear tires will have less grip. More load/grip up front means the car will be more responsive to our steering input, and we'll have to give less input.

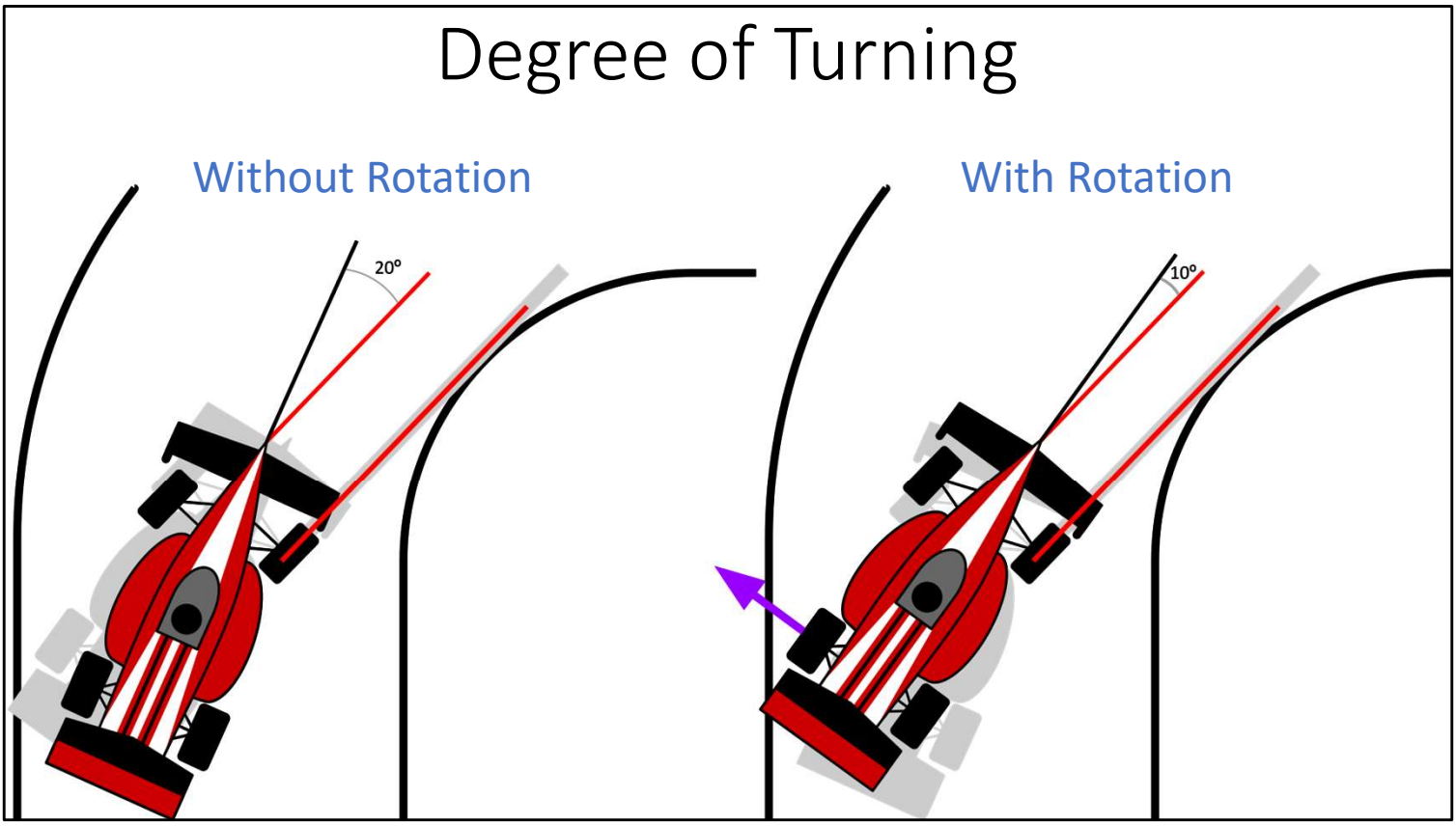
More load up front will also leave the car with less load/grip in the rear. Consequently, the rear tires will have less traction and will be willing to slide out a little. In the image above, the purple arrow indicates the rear tires sliding out a little due to trail braking. The grey car underneath did not rotate because the driver did not trail brake. For the grey car, the front wheels have to be turned more, and they have to work harder to make it to the apex.

More weight on the front tires and less on the rear means the car turns more easily (rotates) with less steering input.

Rotation is similar to oversteer, but it's worth thinking of them differently. Oversteer can be considered a property of a car that isn't as balanced as it could be. Oversteer is something the driver has to deal with and compensate for. Rotation is something the driver asks a car to do. The more balanced a car is, the easier it is to control the amount of rotation. Maybe you can think of rotation as *induced* oversteer. It is a good thing, whereas unwanted oversteer is not good.

A benefit of rotation is that our wheels are straighter as we approach the turn. Straighter wheels provide better grip. This better grip lets you brake more later into the turn (prolonged trail braking). Straighter wheels also let you apply more throttle and we cover this in the "Finding Gains" presentation. As a general rule: the less you turn the steering wheel, the faster you can go.

Degree of Turning



The diagrams here are to emphasize that when the car rotate, the drive has to provide less steering input.