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MORE TRACKS, MORE TRACK TIME

Classroom Instructional Materials

General Driving Tips

Look Ahead

This tip all relates to hand-eye coordination. Look where you want your hands to drive you, and look far enough ahead to take advantage of the feedback. If you're looking at that outside cone that you're afraid you'll hit, well, you'll hit it. If you're looking ten feet in front of the bumper, the turns will keep surprising you.

Slow Down to Go Fast

A common problem when you're starting out is trying to take the tight sections too fast, and not staying in control. You will be faster if you are smooth than if you are on the verge of being out of control.

Brake Hard For Corners

Go ahead; squeeze the brakes hard. There's no morning coffee on your dashboard, or eggs in the front seat. Once you decide to slow down for the corner, don't waste any time. If you find yourself at a crawl and you're not at the corner yet, why, you've just found out that you can brake later. Locking up your wheels will not make you stop faster, so squeeze the brakes and let them do the work, not your tires.

Adhesion

Don't ask too much of your tires. For any tire/pavement pair, there's only a certain amount of traction. We'll call that 100% traction. You can use up that traction with your throttle, your brakes or your steering wheel. So if you're going into a corner, using 100% of your traction to make the turn, what happens when you ask for more traction by applying the brakes? Either you won't brake or you won't turn. Or both. The same goes for accelerating out of a corner: ease in the throttle as you ease out of the turn. So use full throttle and full braking only in a straight line. This goes back to slowing down to go faster, and brings us to...

Smooth Inputs

This is where you have to change your mind-set about inputs to controlling your car. You need to convince yourself that you can make your car respond better by squeezing the brakes hard instead of standing on the brakes; by rolling in the throttle rapidly instead of stomping on the gas; by turning the wheel quickly instead of cranking it around. Subtle, but it will show up in how often your car is in control instead of scrubbing off speed pushing around a corner. And it will take a lot of practice to become second nature.

The Corner Workers are Your Best Friend

Everyone should take their yellow flag laps to find the corner workers at each corner. They will be the ones to help you in the event of an accident. They will also be the ones to show you the flags to warn you of danger ahead.

The Flags

Track flags are displayed by the corner workers to protect and inform you. Below is a summary of them.

Green Flag – "GO" A track session is underway. The course is clear.

Yellow Flag – "CAUTION" Approaching a hazardous area.

Stationary – Proceed with caution, no passing; be prepared to alter your line if necessary.

Waving – The track may be obstructed ahead. Slow down and be prepared to move off-line as necessary… CHECK MIRRORS BEFORE SLOWING! NO PASSING!

Yellow and Red Stripe Flag – "DEBRIS" There is debris on the track, such as oil or car parts. Drive with care, prepare to move off-line as needed.

Blue Flag with Diagonal Yellow Stripes – "YIELD" Passing flag, a faster car is behind you and you should let them pass. Stay on-line and lift off the throttle slightly to allow the pass to be complete.

White Flag – "SLOW VEHICLE AHEAD" there is a slow moving vehicle on the track ahead, be aware, pass with care.

Black Flag – "PIT NOW"

Furled (rolled up and pointed at you) – You are driving in an unsafe manner. Finish the lap you are on, proceed directly to the pits, and be prepared to talk with an event official.

Stationary (open) – "Black flag all" – when all corner stations display a black flag, all cars should enter the pit lane at the next opportunity. The course must be cleared. There is a need for track clean up and safety crews will enter the course.

Meatball Flag – "PIT" There is a mechanical problem with your car. Drive your car to the pits as soon as possible or pull off the track near the next corner worker station (if there is a fire). Stay off line.

Red Flag – "STOP SAFELY" Indicates an emergency situation. Check your mirrors and bring your car to a controlled stop on the right side of track. Stay on the track, in your car, wait for a signal from corner workers.

Checkered Flag – The session is over. You must pit. Use this last lap to cool off the car and proceed to exit from the track at the next pit entrance.

Safe Passing

Will I Pass or Be Passed?

Why does passing take place? With a variety of cars and drivers, someone is always going faster that you. Yes, it's true; you are not the fastest driver on the track! At some point, a faster driver will catch up to you. Allowing passing creates a safer track environment because it allows for free flow of traffic, and separates cars on track. The result is a safer environment because drivers stay calm, relaxed, and receptive to learning. Allowing safe passing on track will also allow you to practice the techniques being taught in this classroom and have fun.

FUNDAMENTAL: Passing can only occur if drivers acknowledge each other and proper signals are used. A driver ahead must see and signal to the driver behind. The POINT-BY signal means, "I see you, it's safe to pass on this side". A driver behind must follow until the driver ahead gives the appropriate signal. PASSING IS NOT PERMITTED WITHOUT A POINT-BY SIGNAL, EVER!

Executing the Perfect Pass

The Perfect Pass situation starts with Track Etiquette AND understanding where are the appropriate passing zones. Passing can occur only in designated straightaways on the track. A slower driver has an OBLIGATION to permit a faster driver to pass.

FOR THE DRIVER AHEAD:

- Identify a faster driver behind by observing your mirrors. A faster driver is one that is following closely in TURNS and BRAKING ZONES.
- Recognizing that a faster driver is following, you must now allow the pass at the next passing zone
- Finish the preceding turn safely through track-out, continue at speed into the passing zone and on-line
- PROMPTLY after track-out, Give the point-by signal, extending your arm and hand fully out the window, pointing clearly in the direction that you want the following car to go.
- Continue on your current path, or 'line', and maintain your speed, nice and steady. STOP ACCELERATING, but, do not slow your car.
- The following car should move 'off-line', and accelerate to complete the pass, then move back 'on-line' ahead of you.

FOR THE DRIVER BEHIND:

- You've caught up to the car ahead of you. RELAX. Be patient, you must wait for an appropriate passing zone on the track.
- Follow closely, but, DO NOT TAILGATE. Maintain a consistent interval to the car ahead.
- Finish the turn preceding the next passing zone, and prepare to receive a passing signal. Caution about over-anticipating... you cannot initiate the pass until you receive the signal!
- Observe the point-by signal, the driver ahead shows his arm and hand out the window.
- Move your car in the direction that is signaled, and accelerate HARD. You want to complete the pass promptly for safety. Do not 'hang-out' alongside another car. Going side-by-side is undesirable, and should be for brief periods only.
- After passing the car ahead, maintain your passing line on track for several car lengths before moving back 'on-line', ahead of the car you've safely passed.

Terminologies and The Line

A. Lift Point – a fixed point, spot, crack, line, etc. where you lift off the throttle. The time between A and B should be a constant.

B. Brake Point – A fixed point where brakes are applied. To change B, do so by changing A. All of your braking should be completed by point B (unless you are trail braking).

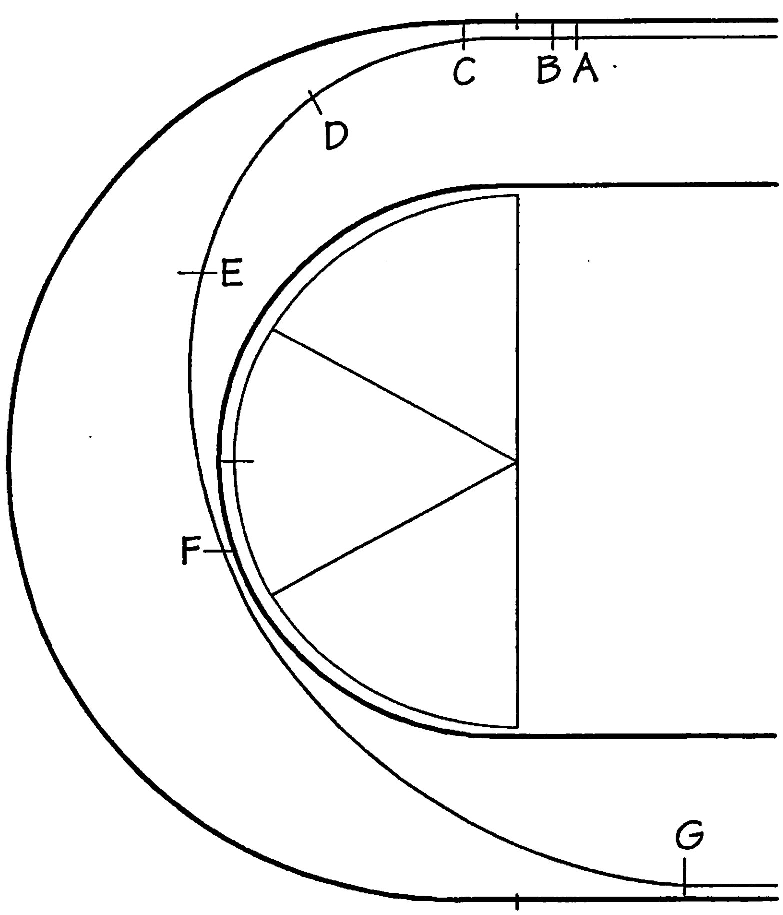
C. Turn in Point – A fixed point where steering input begins.

D. Acceleration Point – This point varies upon the success and smoothness of A, B, and C. This is where throttle input begins.

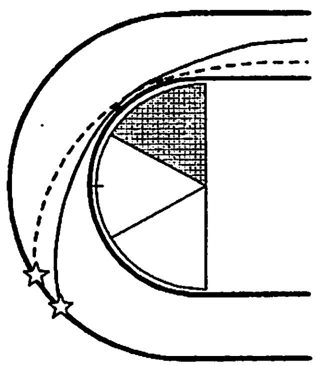
E. Full Throttle Point – An approximate point where full throttle begins.

F. Apex – The point, sometimes area, at the inside of the curve where the line most closely approaches the edge of the road.

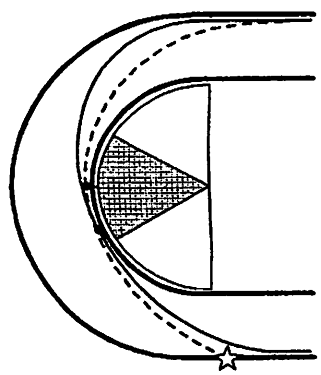
G. Track Out – The point where the turn ends.



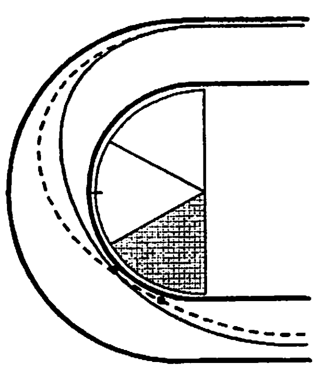
The Apex. Early, Mid, and Late



Early Apex. As you can see, hitting an early apex on this turn enables you to also hit the wall. If you were able to make it through the turn safely, you would have to do it very slowly. Always remember ...early apexers make great landscapers!!!!

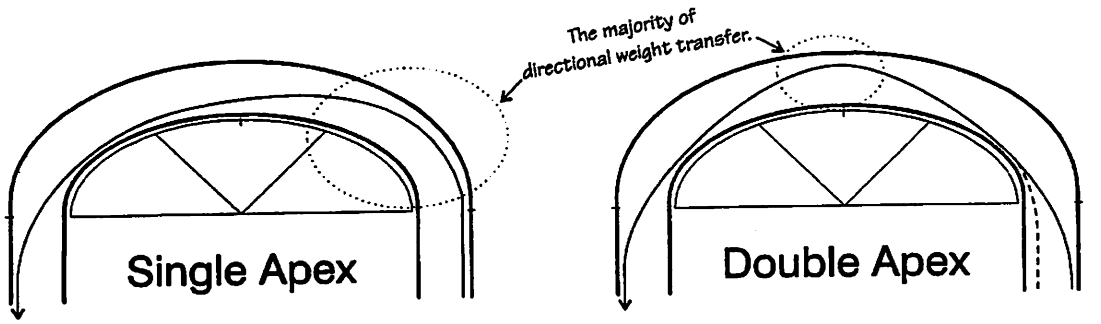


Mid Apex. Apexing somewhere through the middle of the turn, in this case, can make you or break you. A "later" mid apex will give you maximum use of the track width needed for the greatest exit speed. Apexing a few feet sooner will either scrub off exit speed or door paint on the wall.



Late Apex. Apexing late is always the safest line and the one we teach in this class. When learning a new track, or turn, you should always start late and then slowly bring the apex back towards the mid apex; that is until you use the entire track and none of the wall on the exit. Notice how much track is not being used on the exit of the turn.

Apex Types



A single apex has a larger radius enabling a smoother weight transfer of the car over a larger turning track area. The braking and the majority of the turning is done in the first third of the corner allowing the driver to accelerate sooner than a double apex. When you are trying to change the direction of a 3000 lb. Car, you want the largest area possible with the least amount of angle

The double apex offers two important opportunities. First, coming from a long, fast straightaway, you can carry that speed longer if you take it deep into the turn. You have to consider though, how long is the straightaway. You will not have near the exit speed using this technique. This is best following a very long straightaway such as Turn 1-2 at Roebling and turn 17 at Sebring.

Notes:

Weight Transfer

Balancing a car is controlling weight transfer using throttle, brakes, and steering. You will often hear instructors and drivers say that applying the brakes shifts weight to the front of a car and can induce oversteer. Likewise, accelerating shifts weight to the rear, inducing understeer, and cornering shifts weight to the opposite side, unloading the inside tires. But why does weight shift during these maneuvers? How can weight shift when everything is in the car bolted in and strapped down? Briefly, the reason is that inertia acts through the center of gravity (CG) of the car, which is above the ground, but adhesive forces act at ground level through the tire contact patches. The effects of weight transfer are proportional to the height of the CG off the ground. A flatter car, one with a lower CG, handles better and quicker because weight transfer is not as drastic as it is in a high car.

It's all about physics

Most people remember Newton's laws from school physics. These are fundamental laws that apply to all large things in the universe, such as cars. In the context of our application, they are:

The first law: **a car in straight-line motion at a constant speed will keep such motion until acted on by an external force.** The only reason a car in neutral will not coast forever is that friction, an external force, gradually slows the car down. Friction comes from the tires on the ground and the air flowing over the car. The tendency of a car to keep moving the way it is moving is the inertia of the car, and this tendency is concentrated at the CG point.

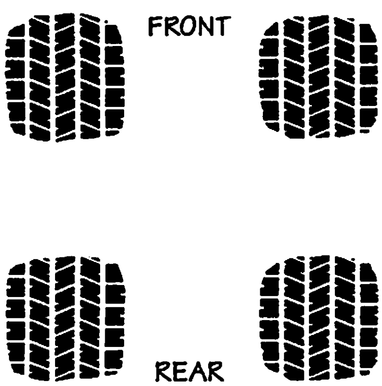
The second law: **When a force is applied to a car, the change in motion is proportional to the force divided by the mass of the car.** This law is expressed by the famous equation $F = ma$, where F is a force, m is the mass of the car, and a is the acceleration, or change in motion, of the car. A larger force causes quicker changes in motion, and a heavier car reacts more slowly to forces. Newton's second law explains why quick cars are powerful and lightweight. The more F and the less m you have, the more a you can get.

The third law: **Every force on a car by another object, such as the ground, is matched by an equal and opposite force on the object by the car.** When you apply the brakes, you cause the tires to push forward against the ground, and the ground pushes back. As long as the tires stay on the car, the ground pushing on them slows the car down.

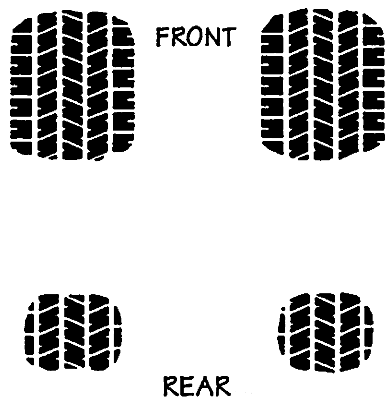
How do these physical laws apply to my car?

- A car at rest has a determined weight balance or bias (corner weights). When a car begins moving, the suspension and motion creates a constantly changing weight balance. For example, the moving weight transfers forward during braking and shift rearward during acceleration. During cornering, the weight transfers sideways or laterally.
  To achieve maximum traction (equating to maximum speed or safety), you must master weight transfer control. The diagrams below show the tire contact patches (tire contact area to the track surface). To put it very simply; the larger the tire contact patch, the more traction there is on that tire to do what you need to do such as steer, accelerate, and/or brake.

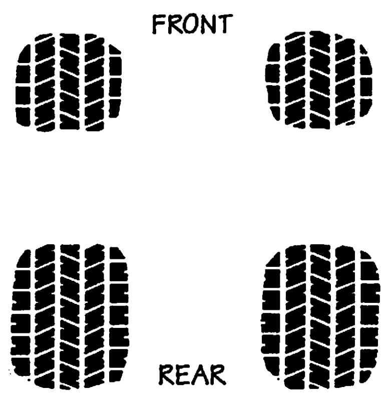
Straight Line



Tire contact patch on a car at rest with a 50/50% weight distribution.

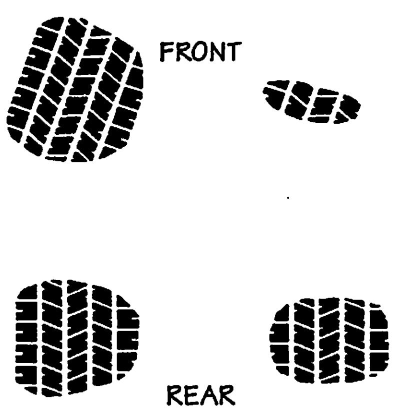


Tire contact patch on a car under heavy braking.

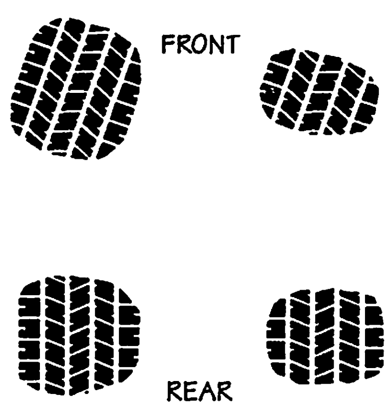


Tire contact patch on a car Under heavy acceleration.

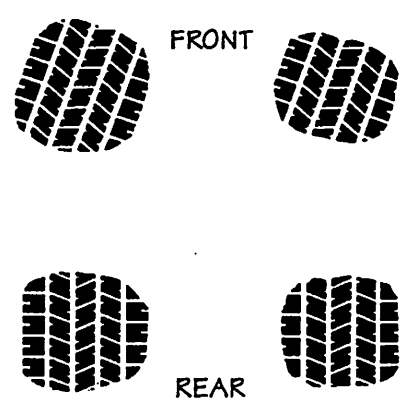
Right Hand Corner



At the entrance of a turn **(Turn-In)** the left front tire becomes responsible for almost all of your corner entrance steering.



Through the middle of a turn **(Apex)** the car begins to settle. Weight begins to transfer back to the right side. This enlarges the contact patch on the rear wheels enabling throttle input (acceleration)



Exiting the corner **(Track-Out)** weight continues transferring to the right side allowing additional throttle. The car begins to stabilize for the straightaway.

Now you know why weight transfer happens. The next topic that comes to mind is the physics of tire adhesion, which explains how weight transfer can lead to understeer and oversteer conditions.

Tire Grip and Oversteer versus Understeer

At this point we need to investigate what causes tires to stay stuck and what causes them to break away and slide. We will find out that **you can make a tire slide either by pushing too hard on it or by causing weight to transfer off the tire by your control inputs of throttle, brakes, and steering. Conversely, you can cause a sliding tire to stick again by pushing less hard on it or by transferring weight to it.**

The coefficient of static friction (grip between the tire and the road) is not exactly a constant. Under driving conditions, many effects come into play that reduces the stiction of a good track tire to somewhere around $1.10G$. These effects are:

- Deflection of the tire
- Suspension movement
- Temperature
- Inflation pressure
- Road conditions....dirt, oil, water, debris etc. on the road

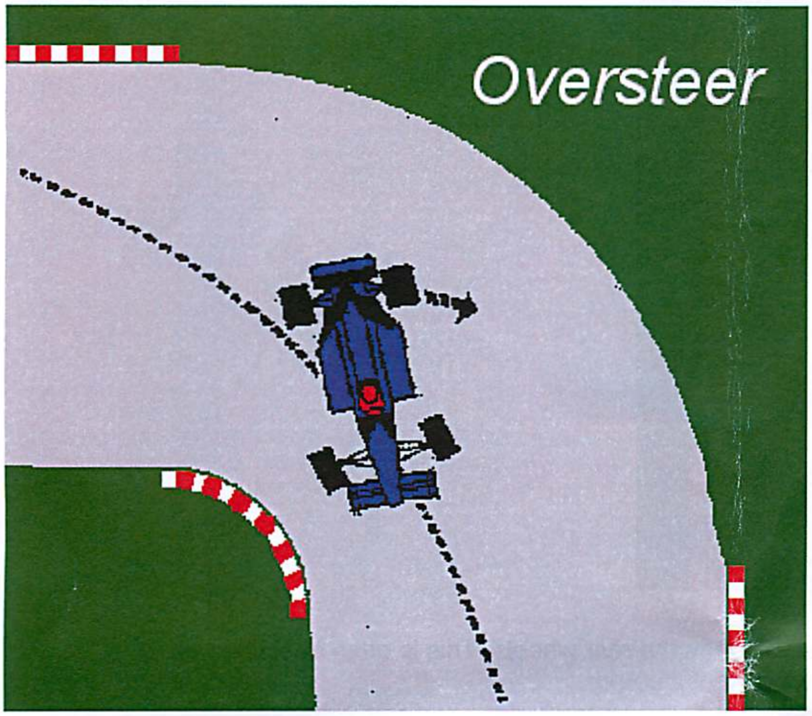
Now you can see that if you are cornering, braking, or accelerating at the limit, which means at the adhesive limit of the tires, any weight transfer will cause the tires unloaded by the weight transfer to pass from sticking into sliding.

Actually, the transition from sticking `mode' to sliding mode should not be very abrupt in a well-designed tire. When one speaks of a ``forgiving" tire, one means a tire that breaks away slowly as it gets more and more force or less and less weight, giving the driver time to correct. Old, hard tires are, generally speaking, less forgiving than new, soft tires. Low-profile tires are less forgiving than high-profile tires. Slicks are less forgiving than DOT tires. But these are very broad generalities and tires must be judged individually, usually by getting some word-of-mouth recommendations or just by trying them out on the track. Some tires are so unforgiving that they break away virtually without warning, leading to driver dramatics usually resulting in a spin. Forgiving tires are much easier to control and much more fun to drive with.

``Driving by the seat of your pants" means sensing the slight changes in cornering, braking, and acceleration forces that signal that one or more tires are about to slide. You can sense these change literally in your seat, but you can also feel changes in steering resistance and in the sounds the tires make. Generally, tires `squeak' when they are nearing the limit, `squeal' at the limit, and `squall' over the limit. Tire sounds can be very informative and you should always listen to them while driving.

Now, what happens when the limits of the tires are exceeded?

Oversteer



Oversteer is when the rear wheels are carving a larger arc than the front wheels or the intended line of the turn. Rear "slip angles" exceed those of the front tires. This is often described as a "loose" condition, as the car feels like it may swap ends, or be "twitchy."

There are two mistakes that can cause oversteer.

1) Power Oversteer

Power Oversteer is caused when you accelerate faster than the rear tires can maintain traction. The backend of the car steps out and tries to pass the front end. This can happen on the track when a high horsepower car accelerates too fast out of a slow turn.

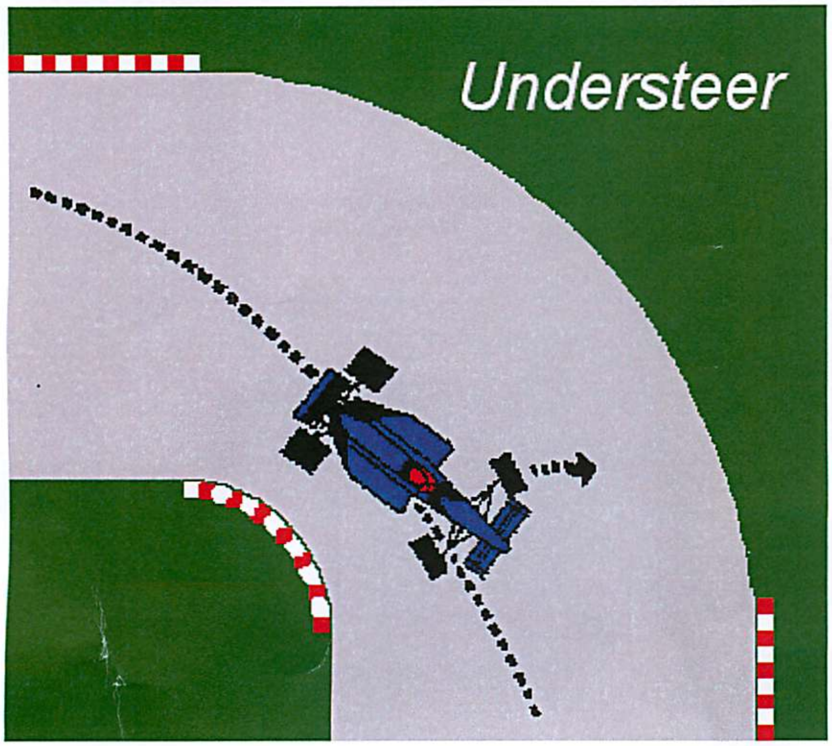
The correction for power overseer is to steer into the turn (opposite lock) and reduce the throttle input. As soon as control is regained the wheel can be returned to a neutral setting and power can again be applied slowly.

2) Limit of Adhesion Oversteer

This type of oversteer is caused by entering a corner too fast for the adhesion of the tires or by asking the car to turn too sharply. The front end of the car will turn but the rear end looses traction and slides out, attempting to pass the front end.

The correction for limit of adhesion oversteer is to turn the wheel into the direction of the slide (opposite lock) and increase the throttle input. This is one of the hardest concepts for drivers to understand and also why most American cars are designed to understeer. It is unnatural to want to add more power when the car is on the edge of control. However, it is essential if you are trying to avoid a spin.

Understeer



Understeer is when the front wheels are carving a larger arc than the rear wheels. This is often described as "push" or "pushing" - as the front end feels like it is plowing off of a corner.

Further acceleration only compounds the push, as weight shifts back to the rear drive wheels off of the front turning wheels, leading to a further lessening of the car's ability to turn in.

Understeer can be corrected by slight reduction in throttle to transfer weight forward to the front wheels, aiding their traction and ability to carve the turn.

Many cars are designed to have a tendency to understeer. If the driver gets uncomfortable and "lifts" off the gas, that will cause the front end to tighten the curve - a relatively safer, and more predictable condition.

Recovering from loss of control:

TIPS TO MINIMIZE LOSS OF CONTROL:

- Stay within your limits or below; physically and mentally.
- Stay calm, focused, relaxed, and hydrated
- Look ahead, drive your car, and avoid chasing the car ahead
- Have goals: 1. Return home with car just a little dirtier; 2. Learn and have fun!
- Listen and learn from your instructor(s), this classroom packet, and 'racing' books. Becoming an advanced driver takes years of development. It won't happen in one day.
- Bring mechanically sound car to the track; make sure you go through Tech sheet
- Use street tires
- Properly cool your brakes by driving moderately on the 'in-lap' prior to pitting.
- Seat Time! Learn to FEEL and hear the tires, and the car's nuances and sounds
- Avoid 'Red Mist': The instinct to chase the car ahead.
- If fatigued, STOP, go home!
- During warm up and cool down laps, make sure you are acquainted with all corner worker stations, run-off areas, and recognize dangerous corners

OOPS LOST CONTROL, NOW WHAT?

Stay calm and **DO NOT PANIC**. You will have split seconds, if lucky, to make decisions. LOOK WHERE YOU WANT TO GO! Then, keep in mind that when you brake you will loose your steering ability, so make sure car is sliding where you want to go before braking. The faster you are going during the loss of control, the less recovery time you will have.

THE 'TANK SLAPPER'
This is when the rear of the car oscillates from side to side. And, happens when over correcting an oversteer situation (mechanically), or via power oversteer (driver aided). To recover from a tank slapper, loosen your grip on the steering wheel, while maintaining steady speed. Do not accelerate and do not slam on the brakes.

GOING WIDE AT TRACK-OUT and off
This is caused by initiating your turn-in too soon or entering the turn too fast. This is the most dangerous and most common driver error you want to avoid. The only way to save this situation from a wreck is to DRIVE THE CAR. Again, emphasize stay calm, and look where you want to go. When you go off: Try to slow the car down, SLOWLY. However, if you go FOUR-WHEELS OFF: Watch your mirrors and corner worker signals before gently and smoothly bringing the car back on track. It's OK to drive on grass, unless is wet.

LOSING IT AT TURN-IN and about to spin
This usually happens due to brake fade, not slowing enough at turn-in, or tire lock-up due to over braking. If there is an escape/run-off area, go straight and use it to slow down. Make sure you don't apply the brakes until the car is traveling in the path you want to go.

SPINNING
If you spin, end the spin quickly by putting "BOTH FEET IN" (Clutch & Brake).
If an impact will occur, protect yourself by letting go of the steering wheel and cross your arms in front of you.

REMINDER: Before you come back to track surface from 4-wheels-off, wait for the corner worker to signal you back in – DO NOT JUST DRIVE BACK ONTO HOT TRACK. Then, drive to the pits.

Trail Braking

Trail-braking is a subtle driving technique that allows for later braking and increased corner entry speed. The classical technique is to complete braking before turn-in. This is a safer, easier technique for the driver because it separates traction management into two phases, braking and cornering, so the driver doesn't have to chew gum and walk at the same time, as it were. With the trail-braking technique, the driver carries braking into the corner, gradually trailing off the brakes while winding in the steering. Since braking continues in the corner, it's possible to delay its onset in the preceding straight braking zone. Since it eliminates the sub-optimal moments between the ramp-down from braking and the ramp-up to limit cornering by *overlapping* them, entry speeds can be higher. The combination of these two effects means that the advantage of later braking is carried through the first part of the corner. In many ways, this is the flip side to corner exit, where any speed advantage due to superior technique gets carried all the way down the ensuing straight. The magnitude of the trail-braking effect is much smaller, though: perhaps a car length or two for a typical corner. Done consistently, though, it can accumulate to whole seconds over a course.

Not all the fast drivers use trail braking and instructors usually give it at most a passing mention as an optional, advanced technique. The reason is a risk-benefit analysis:

- It's a small effect compared to the big-picture basics, like carrying speed *out* of a corner, that everyone must learn early on
- It's difficult to learn, so why burden new students with it?
- Mistakes with it are ugly

As with most driving skills, it's difficult to get a feel for the limits without exceeding them from time to time. However, exceeding the limits at trail braking has some of the worst consequences one can invite on a race track, typically worse than those from mistakes at corner exit. It's definitely a big risk for a small effect, justified only because it accumulates. Blowing it results in *too high an entry speed*. You get:

- Inappropriate angular attitude in the corner
- Immediate probing of the understeer or oversteer characteristics of the car
- Surprise, pop quiz on the driver's car-control skills
- Missed apex and track-out points
- Looming penalty cones, gravel trap, tire barrier, concrete wall, tree, etc.
- When you bounce back from *that* impact, you can hit other cars, spectators, corner marshals, berms, etc.
- Anything else that can go wrong in a blown corner

High horsepower cars are fun and loud and attract a lot of attention. Paradoxically, though, such cars can lull one into becoming a lazy driver. With a lot of power on tap, you can often make up for an overly conservative entry speed on the exit.

However, when the cars are equalized, as in spec races, showroom stock, or in a lot of Solo II car classes, trail braking takes a prominent role. It can be difficult to spot it as an issue in Solo II, where drivers are alone against the clock. All else being equal, a Solo II driver without trail braking may just find himself scratching his head wondering how in blazes the other drivers can be so much faster. Go wheel-to-wheel on the track with equal cars, though, and the issue becomes instantly and ***visually obvious***. You may be just as fast *in* the corner, coming *out* of the corner, *down* the straight. You may have perfect threshold braking. You may have perfect turn-in, apex and track out points. But that little extra later braking and entry speed will allow the trail-braker to take away several feet every corner. Corner after corner, lap after lap, he will gobble you up.

Shuffle Steering

A more accurate and less dramatic method of wheel-handling. For example, for a left turn, the left hand moves to the top of the steering wheel and pulls the wheel a full half-turn to the bottom, while the right hand slides downward to meet the left hand at the bottom. The right hand then pulls up on the wheel, while the left hand mirrors the movement until both hands meet at the top. This takes some getting used to, but is very efficient.

Heel and Toe Shifting

The heel-toe downshift is a fundamental technique to driving fast through corners. During a heel-toe downshift, you'll be steering with the left hand, shifting with the right hand, clutching with the left foot, and working both the brake and gas pedals with the right foot -- all at exactly the same time.

It takes some getting used to, and it takes repetitive practice to become smooth, and have it be second nature. At first it takes a lot of concentration. You're doing a lot of things at the same time. Besides working on all the controls, you also need to be sensitive to the tire grip during braking, you have to be watching your reference points heading into a corner, and to make matters worse, if you're racing, you might have to be looking for traffic. However, after a couple of weekends of practice, you'll get the hang of it, and in no time you'll be able forget about your hands and feet, and concentrate on the track.

On the street when you approach a corner, you were probably taught to complete your braking before the corner, coast through the turn, then as you straighten out from the turn downshift, and start accelerating again. This works on the street, but it is entirely too slow a process for the racetrack.

For racing, the time spent transitioning from braking to accelerating must be absolutely minimized. You're racing! You don't want to be wasting a bunch of time coasting while you're switching between pedals (even if it is only 1/2 of a second). To maximize the speed and smoothness through a corner, it becomes necessary to do some cockpit acrobatics and operate the steering wheel, shifter, clutch, brake, and accelerator all at the same time.

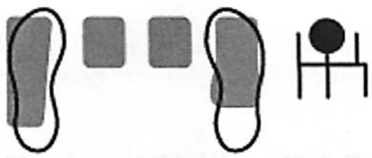
On the race track, as you approach a corner, your right foot comes off the gas pedal and presses the brake with the ball of the foot. Before the braking is done, you need to shift gears so when the braking is done you can immediately be back on the gas. When the braking is almost done, your left foot pushes the clutch pedal in, and your right hand downshifts. However, while you've been slowing down, the engine speed has dropped. If you let the clutch out now, the car will jerk severely as the engine works like a huge brake. If you're at the edge of traction limits, you'll lose control of the car. To prevent this, something needs to rev the engine back up to the right speed before the clutch is released. The right foot is closest, so it is elected to tap the gas pedal. Even though the right foot is busy braking, you swing your right heel over the gas pedal and give it a short push (a "blip" as it is called) to rev the engine while the left foot also lets out the clutch (the ball of the right foot is still on the brake). The amount of blip, and the clutch release timing need to be perfected so there is a perfectly smooth transition when the clutch engages the engine. Meanwhile, the heel is rotated back off the gas; the ball of the right foot has still been braking, and has been easing off as the car approaches the turn-in point. The downshift should be completed before the braking is complete, and before the turn-in. As the engine and transmission are engaged, the braking reduced, and the turn-in begun as the foot makes a smooth transition back to the gas pedal. At first only enough gas is applied to sustain the initial corner speed, and then you gradually accelerate out of the corner.

The above description is the "what" and the "why" all mixed together, so let's look at the just the steps involved in the "what" part again:

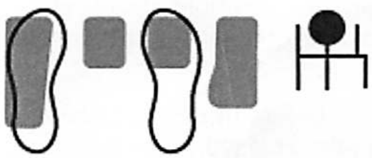
- Lift the right foot from the gas pedal and press the brake pedal
- Just before the braking is done, the left foot depresses the clutch pedal
- The right hand downshifts (the left is still on the steering wheel)
- The right foot is still applying, but easing up on the brake pressure, then rotates so the heel is above the corner of the gas pedal
- The right heel gives a quick push of the gas pedal to rev the engine quickly (the ball of the foot is still on the brake easing up even more)
- The left foot releases the clutch, the right foot rotate off the gas
- The right foot completes the braking
- The right foot slides over to the gas pedal to assume the normal position only to maintain some pressure to sustain the vehicle speed through the first part of the corner. Then accelerating out of the turn.

The whole sequence above from the second bullet to the last takes less about half a second. This takes quite a bit of practice to get right. The whole idea is to transition between braking and accelerating with absolutely no delay, and with perfect smoothness. Done correctly, there should be no jerking of the car during the downshift and transition back to acceleration.

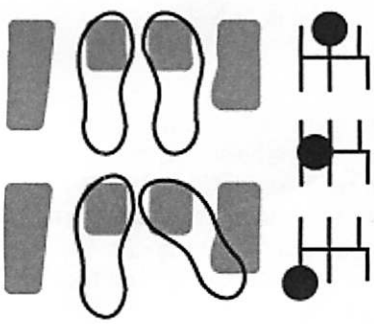
One other note about the above description; we have assumed the use of a streetcar, and a street transmission with synchros. If you're using a true race transmission without synchros, then you need to modify the above shifting with a double-clutch procedure. To do this, the clutch is pressed in, the shifter moved to neutral, and the clutch released. Then the accelerator is blipped, while the shifter is in neutral (again with the heel, while the ball of the foot continues to brake), the clutch pressed back in, the shifter placed in the lower gear, and the clutch released. This is required for maximum longevity of the transmission. If you expect to get in a racecar some day that is likely to have such a transmission, it's a good idea to practice this shifting technique with your streetcar as well, even though it technically is not necessary.



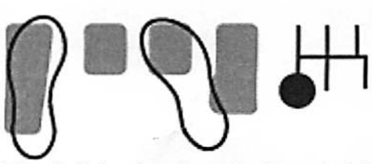
The downshift begins with full throttle acceleration towards a corner.



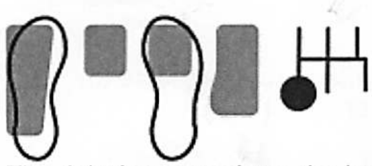
Lift the right foot from the gas pedal and press the brake pedal.



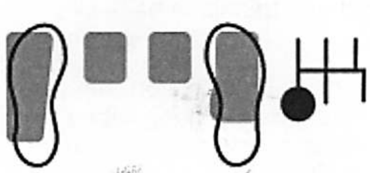
Just before the braking is done, the left foot depresses the clutch pedal.
The right hand begins the downshift.
The right foot is still applying, but easing up on the brake pressure as the car approaches the turn-in, then the foot rotates so the heel is above the corner of the gas pedal.
As the shift passes through neutral, the right heel gives a quick push of the gas pedal to rev the engine quickly (the ball of the foot is still on the brake easing up even more).



The left foot releases the clutch; the right foot rotates off the gas. Done correctly the RPMs generated by the throttle blip above matches the RPMs needed, and as the clutch is released the engine engages smoothly with the current wheel speed. There should be no forward or braking lurch when the clutch is let go.



The right foot completes the braking with a smooth release.



The right foot moves over to the gas pedal to assume the normal position at first only to maintain the pressure needed to sustain the vehicle speed through the first part of the corner. Then pressure is gradually applied to accelerate out of the turn.