

## ***Introduction:***

Concentration + Smoothness + Consistency = Balance  
And  
Balance = Performance Driving

There's a reason for this – it's true. It's the single most important thing to learn about your driving! Everyday controlled performance driving cannot be realized without your dedications to Smoothness, Consistency and Concentration.

This will be one of our primary focus areas throughout this material as we explore getting from point A to point B. Later we will focus on Smoothness, Consistency, and Concentration to achieve Balance and Performance Driving pleasure. Then we will discuss seating position to help you achieve optimal vehicle feedback. We'll look at learning with "attitude", as well as demonstrate ***Oversteer, Understeer***, "working a corner", and heads up driving. The benefit of slalom courses for learning vehicle feedback will be discussed and "on track" flags will be explored.

Many things affect the dynamics of handling car control. Your car's suspension, tire choice, road conditions, weather, ambient temperature, and your own mental preparation to driving, to name a few. The best handling car with perfect road conditions will still readily leave the road without your controlled input if you lack Concentration and the ability to "work the corner" correctly.

Most cars today have limits, which generally exceed the skills of most drivers.

The techniques covered here do not make your driving skills or your vehicle's handling abilities invincible. Rather, they will help you better understand the issues and how you can narrow the gap between your car's handling abilities and your driving skills.

"Hands-on" practice in a controlled environment, allowing proper attention to safety, is the best and most effective method of implementing these concepts. Playing with a 3500lb animal with 250 hp can quickly get out of hand. Do it right and play safe.

Statistics prove that drivers with some of the more advanced vehicle technology and performance abilities are more likely to run into trouble with a little too much "gung-Ho" attitude. Slow and smooth will advance your skills more efficiently than impatience and a "lead foot".

The purpose in learning these concepts is to develop better driving skills and subsequently better driving habits. This is not a defensive driving course. There are, however, obvious overlaps when considering the aspects of preparation and awareness.

When the time comes that you need this control over the balance of your vehicle, it will be there or you'll know how to achieve it. Accident Avoidance is not an accident! It should be the only incentive you need.

### *Strategy for learning:*

Changing our habits and improving our skills requires an action plan or strategy. Let's not make this too complicated. The basic stumbling blocks to learning typically include personality traits, presentation, habits, subject matter, and quality of instruction.

You are participating in our driving school; it can be difficult to concentrate on "slow first" and then "fast later" when you are overly excited. Take your time in the beginning and you'll get a lot more out of each for your on-track sessions. Work with your instructor to tackle only a couple of things during each driving sessions. Too much information can clutter your senses and allow little opportunity for retentions of what you've learned. Each of us reaches a learning block on many things we investigate. This stumbling block appears at different points for different subjects based on experience and base knowledge. However, everyone can benefit from the strategy of driving slow and smooth before pushing the limit and driving too fast.

Even a baby is smart enough to learn to walk before they run. Take a lesson from baby. Slow down up front. Get the technique, smooth it out, and the controlled, safe, speed will follow.

#### **Attitude**

Think positive, Open-minded, Relaxed, Prepared and Safety conscious.

#### **Ego**

Have large ego? Check it when you register for your driving school. There is nothing wrong with having an ego. Many of you should be proud of yourself. That said, you will always learn more from a course if you leave your ego at home. Remember, you came here to learn, not to teach, brag, or show off. You're not here to impress anybody.

#### **Rest and Nutrition**

You are enrolled in a performance driving school; show up for your school a little early. Be rested! Appreciate that your learning curve and performance will be directly related to your mental/physical state. Dehydrated and tired from a night at the pub is dangerous for you and others, and not too bright. Common sense stuff, right!

#### **Movements**

If you're a little rough and abrupt in your movements, then your first strategy is to slow down your movements and your speed. Be more deliberate in each actions, shifting, braking etc. Animate your movements and do it at a slower pace so you can be deliberate. Think ahead as you approach each section of road. (Don't forget the positive impact of "forward vision" to help in your cockpit movements) Doing very deliberate and controlled movements will tend to slow you down. Get the control in place with these distinct movements.

Once you've established a deliberate, albeit slow, rhythm in your movements as your hands and feet are busy with shifting, steering, throttle, braking etc, then it's time to begin a quicker response time to each of these activities without upsetting the smoothness

and balance you've now started to achieve. Start to exert those actions more firmly. The slower pace frequently accompanies a softer effort. You can begin to speed up the movement by thinking firmer. Animate the firmness. This will not disrupt your already achieved smoothness. Avoid strangling the steering wheel. The pace of your execution will pick up while maintaining the gains in smoothness and deliberate actions. Don't be jerky about it. Improve a little at a time.

### **Heads-Up**

If you can tell me how many scratches there are in your hood ornament then we need to talk. If you have a head up, use it!

The events evolving ahead of you are telling you what is possible and probable so be prepared.

### **Smooth and Focused**

This is how you want to drive! You will not only be driving better and avoiding accidents, but your passengers will be rewarded with a smooth drive while feeling at ease with you at the wheel. You will be better prepared for the mistakes of others around you. Remember there are thousands of other drivers who may not be similarly prepared. At least one of you will be!

## ***Driver Types:***

There are 4 major classifications of Driver Types.

1. Aggressive
2. Confident
3. Practical
4. Passive (timid, nervous)

The ***Aggressive*** driver is the most dangerous. They have little regard for other drivers, and often have a lack of respect for the consequences of the speed they drive. They seldom expect other drivers to appear suddenly behind them. Their skills and /or common sense do not justify their degree of Aggressive driving. Assumptions are often made as to the passive driving nature of those around them, and they leave little room for error. If you suspect even for a moment that you fall anywhere in this category, then please pay close attentions. You are in one of the groups that stand to gain much from this advanced driving school.

The ***confident*** driver type is not necessarily the best driver. In fact, in many cases their skills and / or common sense may not justify their degree of confidence. They may not have a lot of respect for the consequences of the speed they drive. They tend to be somewhat more attentive than the aggressive driver. Harnessing and then building on the confidence is the challenge faced by their driving instructor in an advanced school setting.

The ***Practical*** Driver never pushes the limit. These are probable some of the safest people on the road. They drive well within their means in varying road conditions. Their practical nature lends itself to most of the nuts and bolts of defensive driving. However, keep in mind the saying “The best Defense is a good Offense.” Sometimes being proactive behind the wheel can get you out of some sticky situations. The Practical driver typically has less ego and is more open minded to learning a new way of doing things. Their Point A position is not clouded with any of the over confidence of some driver types, while they are also not nervous about learning something new with their vehicle. They may be the best students, certainly the easiest to work with. They are also less frightening to spend time with in the instructor’s seat. If you are the Practical type, you are probable best prepared for accepting new input and learning.

The ***Passive*** driver types typically make up a minority group in any Advanced Driving School. They are not just passive about their position behind the wheel; this may be part of their personality. This driver type may be the least safe driver, particularly when mixed with confident/aggressive drivers on the road. Their vehicle speeds can sometimes fall far short of the minimum recommended speed limit on a given stretch of road, and a t times, this can be more dangerous than following the posted limits. Passive drivers probably stand to gain the most from an Advanced Driving School. Our primary goal is to make you feel more comfortable with your vehicle and subsequently more confident when behind the wheel. It’s important to feel safer and to enhance your comfort level

when your limit is stretched by unexpected factors. The vehicle you are driving has capabilities that far exceed your personal limits.

As mentioned earlier, we have excluded the extremities of the driver types. We have not included the drunk driver, the careless teenage, the sleepy senior citizen, the cell phone addict or the road bully. It's our hope that none of you fall into those categories if you're taking the responsibility of leaning from this resource.

Educational media or Advanced Driving Schools cannot help these extremists; their problem is not car control, it's lack of common sense.

Try not to over analyze this issue, but do take some time and be as fair as possible to yourself about the details of your driving style. Try to get a realistic handle on where you feel is a realistic representation of your personal "Point A". Be open-minded to lean something new.

### ***Point “B”***

Point B is where your driving skills need to be.

Point B is where you are headed.

Proper seating, Heads-up, Forward vision, Peripheral awareness, Proper attitude, Concentration, Smooth inputs and Consistency is where you need to be.

***Squeeze*** the throttle (don't stomp on the pedal)

***Squeeze*** on the Brakes applying increasing pressure

Steer with ***hands, pushing*** with one and ***pulling*** with the other. No sudden directions change by jerking on the wheel, ***feel*** the car communicating the road surface to you. Do it right each time and every time.

Remember, the “balance” you learn to feel when driving your car will keep you in Control.

## ***Concentration – crucial for safety:***

The number one cause of vehicle accidents is ***lack of attention***.

Heads up! Pay Attention.

It's a fact that 80% of a child's learning comes through vision. It's fair to say that a large percentage of your decision-making while piloting your vehicle will be based on your visual input. If you don't see it coming, you don't have time to react. The less reaction time you have, the less chance you have for avoidance or preparation.

The structure of the human head allows us to use our peripheral or "soft" vision. The eyes are positioned on both sides of the face to achieve this peripheral view. Many of the drivers you encounter might as well have their eyes closed, since they appear to be totally oblivious of their surroundings. Although there is never a guarantee that another driver is actually paying attention, if you cannot see the eyes of the driver in front of you reflected in his rear-view and/or side-view mirrors, then he/she cannot see you, as the mirror is misaligned!

Some of us are better at appreciating our peripheral view than others. It's a matter of exercise and practice. Look up and straight ahead and you can still see what is directly in front of you and to the side (almost 90 degrees in front of both sides). That's a 180 view of the world in front of you. So why focus on your hood ornament? Yeah, it's pretty, but it's not going anywhere and it poses little danger. It's a known entity. It's traveling with you. The telephone pole on your right will not jump out in front of you, as it's not going anywhere either. Let your peripheral vision deal with the position of these objects. The majority of the world around you while driving includes other cars, poles, signs, people and buildings – all of which are reasonable sized objects. Stop trying to avoid the bubble gum wrapper and pay attention to that accident evolving directly ahead of you.

Visual input helps you determine braking distance, speed, safe distance from the car ahead, lane changes, cars in your vicinity and so on. The more input you manage while maintaining awareness of your surroundings, the more concentration attributed to the driving task. Your winning lotto ticket fantasy should be left at home. These will all be key elements in achieving smoothness in your driving technique, learning to link your turns, and in accident avoidance maneuvers.

So we've discussed 80% of our driving input coming to us through our vision sense. What about the other 20%?

Let's consider sound. If you are one of our many drivers with boom boxes pounding out the tunes, just how many emergency vehicle sirens do you figure on hearing and reacting to in a safe and controlled manner? Are you capable of hearing your tire sounds changing as the road surface beneath your wheels changes from asphalt to concrete? How about loose gravel on the surface, or your turn signal indicator?



Finally, consider the “tactile” inputs afforded by weight transfer in your vehicle, road surface changes, centrifugal forces, road grade changes, etc. Manage these inputs together with others to effectively control your car in all circumstances.

### **Smoothness – a key element in establishing car balance**

Quick panic movements can dramatically affect the vehicle’s balance and subsequently the adhesion to the road. Hard braking with out anti-lock brakes (ABS) can lock up the wheels. Locked wheels mean **NO STEERING**. You will **HIT** the object. (ABS is by no means the perfect solution to panic stops...the wheels can still lock up, and steering input can be compromised.)

On the other hand, a sharp sudden turn, especially while you’re braking, will shift the weight of the vehicle forward and to one side, endangering the adhesion with the road surface. This puts the car in an unbalanced condition with friction forces on the front end; tending to lighten the rear end of the car. This leaves the rear end slipping out and traveling faster than the front end. This is not good.

**Solution:** SMOOTH braking inputs do not cause sudden shifts of momentum and weight transfer. Gradually but quickly increase your braking effort. The vehicle’s balance is more easily maintained. This slows the vehicle more effectively to a point where releasing the brake and then steering around the object avoids the collision.

Remember steering is reduced during braking and accelerating. Do your braking and accelerating when the steering input is the least (preferable nil). Let off the brake pressure and then steer to avoid the object. Releasing the foot from the brake at the last moment before steering around the object (or even adding a little throttle here) helps settle some of the weight once again towards the rear of the car, which will assist you in preventing the rear end from sliding out (oversteering) during your avoidance maneuver.

The position and angle of your body will tell you where the vehicle’s weight is. Thrusting into or out of the seat tells you if the front or back end is lightening. Maybe there’s some merit to the expression” driving by the seat of your pants”.

Even the most skilled racecar drivers, in the most advanced vehicles, can get in trouble. Remember that every turn is different and even the same turn is different every time you drive it, even in the same vehicle.

### **Consistency – practice makes perfect**

Accuracy, timing and the smooth application of the throttle are only part of the formula. Smooth application and timing of your braking is generally the first aspect to approaching a corner or unknown section of road.

Practice makes perfect. Driving is not the sort of skill that allows you to master only one aspect of vehicle control and make up for the lack of attention in the others. The speed of your vehicle (doubled when an oncoming vehicle is involved) demands decisive action.

The smooth input skills for steering, braking and throttle are so integrated that you are only as good as your weakest ability.

During this driving school find **consistent** braking zones when approaching each corner or circumstance. As your skills improve, you can start to shorten your braking zones in a consistent manner with input from your instructor. During your slalom exercises, work on a **consistent** steering input for both left and right turns to smooth the weight transitions and limit the jerkiness experienced with abrupt steering inputs. Be **consistent** in your heads up approach to each and every corner entry and exit. When following other cars, in this school or on the road, ensure you **always** look beyond the rear bumper of the car in front and pay more attention to the road ahead! Finally, when performing lapping exercises, pay particular attention to developing the same approach and exit to any given turn or series of turns.

### **Balance – your reward!**

The reward for Smoothness, Consistency and Concentration is maintaining the balance of the vehicle and a safer journey!

When a vehicle is **Balanced** you have more options to control the vehicle's momentum and direction since you are, in effect, optimizing the car's weight on each tire contact patch. You may apply throttle or brake. You can slow your car down, speed it up and make it turn. This is what is commonly referred to as Driving. Doing it with **Balance** is Performance Driving. Doing it out of **Balance** is dangerous.

When a vehicle is Unbalanced, its behavior is no longer necessarily predictable. In the hands of a novice, catastrophe can result. Oversteering, Understeering, Slides, Accidents and Injury.

Always remember: **A *Balanced* car is a controlled car!!**

## *Driver Dynamics:*

### **“How the driver relates to the car”**

#### **Seat Position:**

Place your buttocks firmly into the back of the seat, and follow the suggestions below with respect to the seat’s positioning. This creates better contact with the bottom and back of the seat to receive feedback from the vehicle. If you have a height adjustment, sit as low in the vehicle as you can get while seeing comfortably over the dashboard and ensuring your view of critical instruments on your dashboard. This will lower the center of gravity as well as once again, providing more “car feel” for varying road conditions as well as weight transfers.

#### **Hand and Arm position:**

To determine the seating distance from the steering wheel, your right hand should be able to grasp the steering wheel at 12 o’clock (without being fully stretched... slightly bent at the elbow). Try linking your thumbs over the “thumb rests at the 3 and 9 o’clock position of the wheel for even more control”. I have witnessed many drivers with their seats placed too far back from the steering wheel. This forces a “straight arm” technique for steering input. In order to drive in this way, the shoulder and chest muscles control (larger, less sensitive muscle groups, in contrast to the finer motor control provided by the forearm muscles) for steering. Sitting closer to the wheel allows a bent elbow, use of the forearms, with greatly enhanced driver feedback and “car feel”. It will take a bit of time to get used to this position if it’s new for you, but you’ll be rewarded over the long term. It’s important to make this change!

#### **Feet Position:**

Your feet should reach the pedals such that you can fully depress the pedals without stretching. Your legs should be slightly bent. (If you’ve altered your position forward to achieve ideal hand/arm position as indicated earlier, you’ll find your legs more bent than you are used to. Give it time, you’ll adapt.) A rule of thumb is; your right foot should be able to depress the clutch pedal without stretching. (No, we won’t ask you to clutch with your right foot when driving, simply a positioning technique) Cross it over the left and try this. You should be using the ball of your foot on the brake without resting your heel on the floor.

Many cars today have a flat area on the floor to the left of the clutch pedal known as the “dead pedal”. This is where your left foot should reside when not in use for clutch operation (in case of an automatic transmission, keep your left foot there). By supporting your weight on the dead pedal area, you are able to force yourself back in the seat to allow a “light touch” for your hands when gripping the steering wheel. Too many drivers use the steering wheel as a support mechanism for their weight when negotiating a turn in the road. Try your slalom exercise with your feet poised loosely over your pedals. Then

try it using the dead pedal. It becomes extremely difficult to provide meaningful steering input when you are holding on for dear life to your steering wheel.

**Mirrors:**

Seems obvious doesn't it? Set up your rear view mirror to allow viewing behind you with a flick of the eye, not your head. That is, if you move your head in any way to see behind you, reposition your mirror. I always find it interesting to watch some drivers having to alter their seating/head position each time they want to check their rear view mirror while taking their eyes/concentration off the road ahead for seconds at a time. Don't copy this. Same thing goes for side mirrors. Position your mirrors to require no change in your driving posture. (Some drivers prefer to use the passenger side mirror angled out to assist them with blind spot areas. You may wish to experiment with this to see what's comfortable for you.) Also, you shouldn't be able to see the door, your elbow and yourself in the side mirrors; you want just a sliver of the side of your vehicle in view to maximize the area you see behind you when glancing at your side mirrors.

**Seatbelts:**

Always position yourself in your vehicle correctly and ***Buckle Up***. Keep them firmly tight and your lap belt over your pelvic area, not your stomach. Seatbelts are a must for our driver's training schools.

### *Tire contact patch/Traction circle:*

The *Traction Circle*, sometimes referred to as the *friction circle*, is used as a method of explaining forces during acceleration, braking and turning. Since it is geometric and mathematical based, it is not always the easiest thing to comprehend, and then apply to the real world, but it is some of the most crucial information defining car control.

Assume that your car is capable of handling .9Gs before it loses traction. This is the maximum amount of force that can be placed on the tires from acceleration, braking and turning at any given moment. Accelerating in a turn, braking in a turn, panic stops, dropping the clutch all frequently result in exceeding the perimeter of your car's traction circle with too many Gs. This is what you need to avoid. You have to budget how much traction you have between turning, braking and accelerating. Note: being smooth will let you get to the edge without going over. You'll feel the car slip, as you approach the limit of your car's traction circle, (that's okay, there is still enough adhesion for control with smooth inputs), but going too far beyond this zone will result in loss of control.

Not all cars have the same traction circle. Some will be more ellipses-like vertically or horizontally, depending on the car setup, while others may have limits in braking conditions or during acceleration. Simultaneously, road conditions and surface (wet or dry) will also distort the real circle. Even as your tires wear, this circle is changing shape. Use the circle as a guide to understanding the physics of traction limits; don't bank on it being a big circle.

Once adhesion limit has been reached, the tires lose their traction and then slide.

In an imaginary car, the traction circle may appear circular in dry weather where acceleration, braking or turning can handle up to .9Gs collectively. However, in wet conditions the capacities change, which can be represented by a similarly shaped inner circle. Consider this one shows maximum wet handling forces to half that of dry handling forces.

Also consider with poorer handling vehicles their circle may be quite distorted, where cornering abilities (suspension etc.) do not match the capacities during braking and acceleration. The choice of tires is a significant factor for all vehicles.

Acceleration generates forces against the driving wheels. You can feel the forces push you back in your seat as you step on the gas. If you press too hard or too quickly on the throttle, the tires will spin as a result of exceeding the given limit.

Braking or deceleration also generates forces against those tires. You can feel yourself lift forward in your seat when you step on the brakes to stop the car. Pressing too quickly or too hard may exceed the G limit and the cars wheels lock up and the car slides.

Now consider, turning left or right, which generates (centrifugal) forces. Too sharp a turn (turning combined with too much acceleration or under heavy braking) may break the adhesion and the car slides again.

The concept here is to realize that many of the fore-mentioned forces often act in combination. Avoid braking and accelerating while steering. Do not over extend your traction capacities.

## ***Weight transfer:***

### **Directions of movement**

Your understanding of weight transfer will be critical for achieving balanced driving!

Weight transfer relates directly to the tire ***contact patches***.

### ***Contact Patches:***

Considering that your tires are the only things between you and a slip into oncoming traffic or a ditch, they deserve some respect. Your 4 tiny tire contact patches are what stand between you and a great number of hazards.

These tire contact patches are what hold (sticks) the vehicle on the road. Their effectiveness is impacted by road conditions and tire design. Their ability to perform their job is directly impacted by the balance or weighting of the vehicle.

A vehicle standing still demonstrates 4 equal sized tire patches with an equal amount of pressure applied (in a balanced car) to all four contact points. A vehicle in movement allows for all sorts of possibilities for changes in your tire's contact with the road.

### **Braking:**

When the brakes are applied, the vehicle weight dynamically shifts to the front of the car (***pitch***), applying more pressure to the front tire patches. This increases the front contact patches slightly, subsequently lifting the rear end and reducing the contact pressure on the rear patches.

It's very important to note that even deceleration (lifting off the gas) can achieve this dynamic weight shift and reduce the stability of the contact patches on the rear end. You can "Feel" this weight transfer easily by experimenting and removing your foot suddenly on a dry section of pavement (ensuring no vehicle is behind you) and noting how you tend to slide forward in your seat against the restraints.

So our goal becomes to release throttle/brake smoothly to minimize sudden or radical weight shifts.

### **Acceleration:**

When throttle is applied, the rear wheels exert more downward pressure giving more contact and traction. While this is happening, the front end lifts, reducing contact pressure and traction and subsequently steering effects.

It would seem that you can't win. Well...you can! Balance the vehicle. Use smoother inputs to apply acceleration so as not to dramatically shift the weight of the vehicle. The same is true for braking. Smoother controlled braking reduces the instability of the vehicle and reduces the effect of any weight transfer.

**Cornering:**

Cornering also changes the state of our tiny tire patches. More weight and pressure is moved to the outside wheels (*Roll*). This reduces the pressure and traction of the inside wheels.

Pay special attention to the fact that additional braking or quick deceleration while in the middle of your turn can lighten the rear end enough to lose traction and induce oversteer. You will recall that oversteer is the term given to the moment when your rear wheels lose traction sooner than your front wheels, resulting in the tendency for the car to "swap ends" or spin (*Yaw*). The lesson here? Do not lift off the throttle suddenly in the middle of a turn! This is a common mistake made on icy roads when a driver feels they may be going too fast in a turn and makes this unfortunate realization in the middle of the turn. A sudden "panic lift" off the throttle is far more dangerous than a gentle ease off the throttle and smoothly steering out of trouble.

As you concentrate on processing this information, and applying the proper response, you will begin to realize that small braking and throttle inputs can affect the working of a corner with a positive result by either helping to balance the vehicle or by not upsetting the balance.

Depending on your particular cars handling, suspension, and tires, If a corner is entered too quickly (particularly on a wet surface), your momentum can induce understeer. The front tires will start plowing or slipping on the road surface. They are losing traction sooner than your rear tires and are pushing in the direction of the sidewall and not rolling. Reduce speed and/or the steering input to get the tires rolling and turning. Once again, smooth will carry the day.

These effects are from lateral forces.

More instability is generated from an uncontrolled weight transfer than from smooth controlled braking and acceleration. This instability or looseness can result in upsetting the adhesion forces between tires and road.



### *Understanding Understeer:*

“Understeer” also known as plowing through the turn, Anyone who has driven in winter conditions knows all about lost steering and pushing straight ahead. The slush preventing the wheels from turning, or preventing the front tires from contacting the road surface for grip (especially if you have your foot on the brake – if the wheels aren’t rolling, they are also not steering). These conditions induce severe understeer.

Our corrective actions require reducing speed and steering input (gently and smoothly remember) to get the front wheels rolling so that they steer. Turning back a little in the direction of the plow lets the wheels turn and increase traction. You will feel your steering control returning to you (this can be hard to accomplish mentally, since it involves moving the steering gently in the direction of the slide – towards the hazard on the outside of the turn for just a few moments of time). Easing off the throttle (remember our examples of weight shifts) will transfer weight to the front tires to help them gain more traction, then the turn can be resumed. Remember, you have to overcome the urge to jump out of the gas with your right foot when you find yourself in this situation. A sudden deceleration by letting off the gas suddenly will shift weight quickly forward. This will, of course, make the rear wheels very light, and you could shift from understeer to oversteer very quickly. Once again balance and smooth inputs are key in this situation.

### *Understanding oversteer:*

Our interest in ‘Oversteer’ needs to be about its limits. How does this happen? What did I do wrong? What happens with Oversteer? Where is it taking the vehicle? And how the heck do I get out of this one?

The vehicle is turning more than the driver wants to. This car is on its way to a spin. How does that happen? Oversteer (too much steering input) leads to a spin out. The rear end is coming around the corner faster than the front end is going through it. This clearly related to the earlier discussion on weight transfer. The rear end of the car is lighter than the front. Cornering forces have gone past the adhesion limits of the rear tires before the front tires. They have no choice but to slide.

Our corrective action is to change steering input and maintain steady throttle (rear wheel drive) to counter the sliding out by turning in the direction of the skid. From our earlier chapter on weight transfer, you might remember that applying throttle in this situation might help by transferring some weight back to the rear tires and help them “stick”. In theory, this would be true, providing the rear has enough traction at that momentum to assist in the desired weight transfer. However, the reality is that in this situation, the tires have already passed their limit of adhesion to the road surface. Adding more throttle here will often simply spin them, further loosening their grip! So, steady on the throttle at least until you “feel” you have gathered up the car and then a gradual reapplication of throttle will allow a return to the balanced situation you want to achieve.

## *Cornering:*

### **Understanding Cornering Principals**

Remember that every corner can be different in many ways from the next. The angle or “sharpness” of the turn can be unique. The exit can be visible or “blind”. The road surface and angle of the pavement can differ. The entry speed into the corner can vary from driver to driver and vehicle to vehicle. You may encounter another car at some point in your turn, and if you have not remembered your “Heads-Up” driving, (but instead have locked your eyes on the bumper in front of you) you may be surprised. Vehicles are different too. Front wheel drive cars have some different handling characteristics than rear wheel drive vehicles. However, the majority of the science of cornering has little to do with the vehicle, it’s about the turn.

There are many types of corners: the switch back or hairpin, sweeping, decreasing radius and increasing radius.

Some corners include elevation changes that add challenge while others may be off camber, which requires other considerations.

The lines through these turns are different because the turns are different. The line in any turn may become different due to elevation changes within the turn or consideration of the line to the next turn. Learning the proper line in a turn will help you to negotiate the turn more safely and complete the corner faster.

The idea of proper line (not the advanced aggressive racing line) is the most controlled line through the turn. It’s the one that reduces the risk of adhesion violation.

#### **Additional common terms used when discussing corners:**

##### **Early Apex**

An Early Apex generally results in a more difficult exit (that is, you may run out of road on the exit from your turn) and hence is seldom the fastest way through a corner.

The Early Apex results from an early Turn In Point or turning from the inside or center of the track rather than the outside.

To correct this problem, move more to the outside of the track and wait longer for the turn in point. Slowing down to make sure you “hit the apex” in the earlier driving sessions will be of great help here. Remember...slow early, fast later.

##### **Late Apex**

A late apex generally results in a safe exit, but is not necessarily the fastest route through the corner. However, it is better to be late and safe than early and difficult. A late apex will leave you lots of road room to work with on your exit. Note that sometimes a late exit will result from entering a corner too “hot” or too fast. By the time you have the vehicle slowed down and gathered up enough to turn, the ideal turn in point for a fast corner exit is well behind you!

### **Mid Apex**

This point is a trade off between a fast entry and a fast exit. It would be great to be fast at both ends, but physics doesn't tend to let this occur. Keep in mind that a fast exit becomes more important when it leads onto a straight (for you speed junkies).

By keeping your head up and your eyes looking up the track, you will be able to better gauge the proper apex and subsequently do the required braking and shifting before the correct Turn In Point.

### **Braking Zone**

This is the straight (usually) area before the corner to do all the major braking and down shifting.

### **Turn In Point**

This is the point at which you start the turn. All major braking and downshifting should be completed before the turn begins.

### **Transition Zone**

This is the area where the vehicle is starting to point towards the apex. Trail braking is ending and you'll be on the throttle as the vehicle is straightening for the apex.

### **Unwind**

Allow the steering to unwind out of a corner. The vehicle will have a natural tendency to do this. The mistake of most drivers is to fight it or prevent it.

### **Track Out Point**

This is the point at which you have completed the turn and are moving relatively straight before adjusting for the next turn. I like to consider this the "reward" part of your driving. Hit the proper apex, and you have the enjoyment of getting the power down for a nice exit!

### **4 Phases to the Turn**

Negotiating the turn can be broken into 4 phases;

1. The Approach
2. The Entry
3. Riding The Corner
4. The Exit

As you approach your turn, use your "heads-up" technique to select a "turn-in" point. Do all the heavy braking. Downshift to the gear that you want to be in when you will be balancing the car through the turn and exiting the corner. Heel and Toe shifting would help this transition greatly if you know how to utilize this technique.

Entering the turn requires diminishing brake pressure to allow the car to turn in. Don't just dump the brake pedal and upset the balance. Riding the turn includes any trail

braking to control speed and to keep the vehicle balanced. Ease up smoothly but quickly and immediately find your throttle pedal to begin to gently add power to balance the car towards the apex.

As you head towards the apex, look towards the exit of the turn, utilizing your peripheral awareness to bring your vehicle to the ideal inside line of the turn.

Feed in the throttle gradually on exiting, maximizing RPMs for the straight that follows.

Driving a car is a lot like downhill skiing. You will tend to head in the direction you're looking. The track line is like the fall line. If you want to head to the apex then pointing your head at it will help. Look up to see where you're going. Always keep your vision one step ahead of your vehicle!

The sequence of braking, shifting, looking, throttle and steering come together to produce the end results. All aspects have to be given consideration for this process to work seamlessly. It's making it seamless that's the hard part.

### **Corner Tools**

You are the driver, and the brakes, throttle and steering are your tools. Praying is unlikely to have a positive impact on your vehicle control in the short term, so don't rely on it. All of these tools have amplitude control. Brakes can be pushed hard. Throttles can be mashed. Steering can allow radical input.

Mixing these tools up or applying the wrong dose can cause unmanageable results. While you are learning these concepts keep your speed down. Get the technique and smoothness down first. The best way to learn how to work a corner is to take it slowly.

### **Braking**

The everyday driver uses about 25% of their braking capacity. In a performance-driving environment, braking should be nearing capacity (light squeak). Locking them up is going too far. Sudden heavy brake application can lock up the wheel through a dynamic transfer of weight to the front, and is far less effective. This lightens the rear end throwing the vehicle out of balance, risking Oversteer.

Brakes should be squeezed. You can still apply brakes quickly with a firm rapid squeeze. This minimizes upsetting the chassis and subsequent dramatic weight shifts. Sudden braking or deceleration can get you in just as much trouble as acceleration. Lightened rear end risks Oversteer when vehicle is not braking in a straight line, while rapid weight transfer to the front induces plowing and lost steering control. Whether you are spinning out (Oversteer) or plowing (Understeer) headlong into the ditch, you are still on your way to the ditch.

You will achieve greater and more controlled braking with a balanced vehicle and all four patches solidly on the road.

## **Throttle**

Gas, juice, gusto, pedal to the metal. It's what most car enthusiasts revel in. The interesting thing about throttle is its ability to get you from 0-60 as well as from 0 to deep trouble.

High Torque can instantly wipe out and adhesion factor your tires have with the road. The more powerful your vehicle is, the more skilled you need to be with your use of throttle. The smoother you need to be.

This means very smooth inputs. Tromping on the gas at the point through a corner pointing at the apex will surely break the adhesion between the rear tires and the road (rear wheel drive) and lose the opportunity for a fast exit. Front wheel drive cars will swing wide of the apex and plow to the outside of the corner. Apply the throttle with care, give your tire a chance to maintain traction.

## **Steering**

A light grip on your steering wheel will provide the most useful feedback. The use of your dead pedal is crucial for this light touch. A great deal of car feel comes to you through your steering. Feel the grip of the front tires. Are they plowing? Can you feel the slip angle? Is the steering light or heavy? Are the brakes approaching lockup?

Turning in shifts the weight of the vehicle to the outside wheels, applying more pressure there and lightening the inside wheels. Now the majority of adhesion is on the 2 outside wheels. The need smooth steering inputs becomes even more important in the turn. The speed and smoothness at which this is done determines the amount of effect the weight shift will have.

Once again, steering, as with all the Corner Tools requires smooth input to work effectively.

To help you on your way with Cornering, here are a few pointers for working corners. For all corners, move to the outside of the track before starting your turn in. Error to the side of a late apex for safety.

## **Constant Radius**

The Apex is in the middle of the turn.

## **Decreasing Radius**

The Apex is generally a later Apex. There is less room to exit.

## **Double Apex**

Sometimes the fastest way through a corner is 2 turns, rather than trying a tighter single turn.

## **Hairpin**

The hairpin has a very late Apex.

**Compound Curve**

Multiple turns or a compounded turn needs to be taken in series. It is often best to consider the exit of the final turn and work backwards to plan your line through the earlier turns in a series. This can mean sacrificing the “best” line through the early turns in the series for a better run down the straight following the final curve.

### ***Rear Wheel Drive vs. Front Wheel drive:***

As the name implies, rear wheel drive vehicles generate their “drive” or forward/rearward motion from the rear wheels. The front wheels provide only steering input. Front wheel drive cars generate both steering and power/drive from the front wheels. There are some important differences between these two methods of drive, and we’ll discuss a few of them here.

Front wheel drive vehicles are certainly the most common on our roads today. They have some inherent benefits in limited traction environments such as snow covered roads. The weight of these vehicles is typically concentrated over the front wheels and a lot of traction can be enjoyed. When driving these cars near the limit of adhesion (either on a snow covered road, for example, or in a performance driving school) you will find that they always “push” or lose traction on the front wheels first. This is an important thing to remember, and you may want to review the chapter on understeer to remind yourself how to “get out of trouble” in these situations.

Importantly, it’s also good to remember that the rear end of most of these front wheel drive cars is a lot lighter. So, if you react too quickly by “lifting” off the throttle when you are in a corner too fast, even more weight shifts forwards, and you are not left with much weight over the rear wheels of your car. This car will quickly “swap ends” (*Yaw*) And you will continue into your corner backwards! Remember, Smooth inputs. Ease off the throttle carefully and wait until the front end “hooks up” again with traction. Then steer out of the trouble.

#### **Torque Steer:**

Cars that have the front wheels both “steering and driving” generally exhibit a characteristic known as “torque steer”. You have probably experienced this in your driving experience by the “heaviness” you feel in the steering wheel when you quickly accelerate a front wheel drive car. This is particularly evident when turning at the same time as accelerating. Changing lanes when overtaking another car is a good example of this. You may feel like the car is about to continue onto the left shoulder of the road instead of going straight ahead. This can be very unnerving! Many manufacturers have concentrated on reducing/eliminating this problem, but it is present to a varying degree in all front wheel drive cars.

Expecting this pressure in you steering wheel will avoid surprises. You may find it necessary to grip the wheel a little more firmly during sudden acceleration maneuvers.

You will note that all manufacturers who produce “sports” cars will have a rear wheel drive or all wheel drive model available. Even the traditional front wheel drive manufacturers have often introduced their 2-seaters with rear wheel drive. The delicate handling/steering balance required in these cars is more easily achieved with the drive on the rear wheels.



### ***Threshold Braking Exercise:***

Threshold Braking exercises allow you to experience the effects of wheel lock up or ABS operation (if the car is so equipped). You will learn what your effective emergency braking distance is in the exercise.

The exercise is normally planned out to allow you to get to highway speed. At the marked braking cones you will be asked press hard on the brakes. You should feel the wheels start to lock up... That's the threshold. If your car is equipped with ABS, then when the threshold point is reached the ABS will start to vibrate (pump).

**The point of this exercise is to learn the limits of braking and tire adhesion.**

### *Slalom Exercise:*

In the course of this “Performance driving school”, you will participate in a slalom exercise. These are designed to help you learn and practice many aspects of car control “performance driving”.

Enter the exercise at a moderate or slow speed. This is not about speed; it is about smooth inputs and getting the feel of the weight transfer affect.

***Heel & Toe exercise:***

The heel and toe downshift is a technique performed with your feet during your gear change to a lower gear. Its main purpose is to match the engines RPM with your car's wheel speed during the downshift. This prevents the "wheel grab" or "jerkiness" that is commonly encountered when downshifting.